OCTOBER 195

WIRE AND WIRE PRODUCTS

ON PARADE IN CLEVELAND AT THE WIRE ASSOCIATION MEETING

The VAUGHN MACHINERY CO.
Cuyahoga Falls, Ohio, U.S.A.

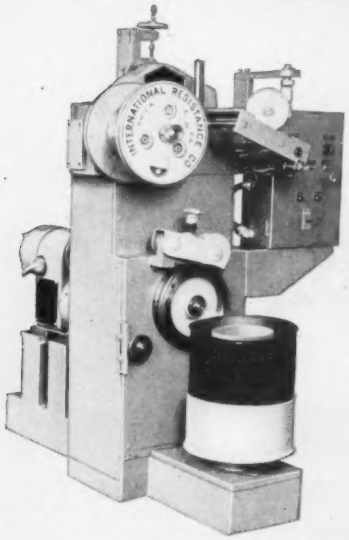
SEE PAGES
1295, 1296, 1297 and 1298.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

COULTER & McKENZIE

CONSTANT TENSION DRAW-PAK EQUIPMENT

FOR CONTINUOUS WIRE PACKING & DRAWING



- Combination drum or spool take-up and rewinder.
- Shown for single wire.
- Adjustable for tension, pitch and amplitude of traverse.
- 12" spool shown. 30 to 150 lb. drums.

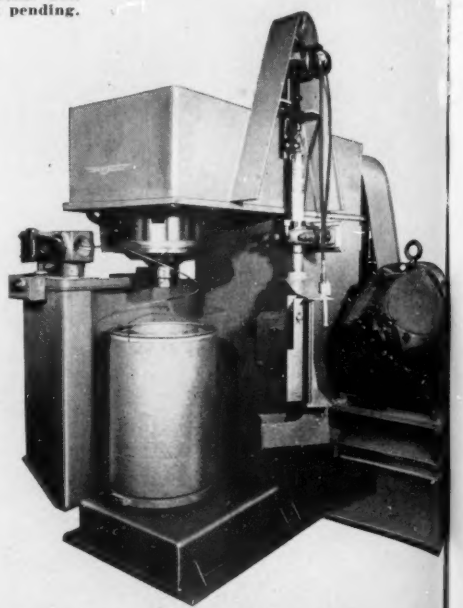
MODEL C-100 TAKE-UP

- Shown with single drive mounting to 16 wires .008" to .051"
- Enameling, annealing, galvanizing, tinning, etc.
- Containers 30 to 150 lbs.

Pat. No. 2,732,060. Other U.S. and foreign patents pending.

MODEL C-500 TAKE-UP

- Shown with tandem drive mounting 8 wires each side .020" to .250".
- Galvanizing, patenting, enameling, etc.
- Drum or adapter weights 200 to 1,000 lbs.



MODEL 138-A DRAW BLOCK

- Single draft wires .016" to .375"
- "Draw-cast" die box shown gives adjustable positive cast control. Also available in other sizes.
- Process adapters to order — drums to 1,000 lbs.

Your inquiry specifying the application which is of interest to you will result in prompt and courteous attention.

Barron & Crowther Ltd., Eastleigh, Hants, England. European Draw-Pak Licensees. Idos Industries Ltd., Royston, Herts, England, Sales Agents.

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SINCE 1843 BRIDGEPORT 7, CONNECTICUT, U.S.A. INCORPORATED 1891

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Cordially Invites

YOU and YOUR WIFE

to

"Swing and Sway the Standard Way"

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Suite 843-845

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during

The Annual Wire Association Convention

OCTOBER 11th THRU THE 14th

John — Earl — Bruce
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Ed

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

Standard Industrial

COMPOUNDS CO., INC.
Member WAS

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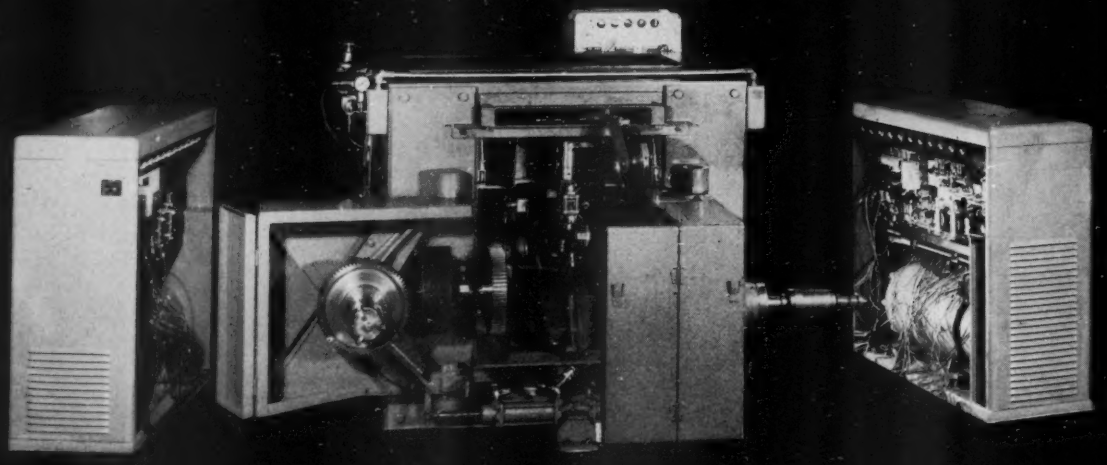
(A suburban Chicago area city)
Telephones: 2131 - 2141

24-HOUR AUTOMATED WIRE PRODUCTION

WITH THE NEW

LITZLER TRANSFER ★ MATED

DRAWING MACHINE TAKE-UP



★ Round-the-clock winding of all non-ferrous wire types at speeds to 5000 FPM.

★ Rugged electronic control and individual drive systems provide instantaneous transfer between dual reels—automatically!

★ Electronically measured winding of 24" or 36" reels precisely synchronized with drawbench speed and tension.

★ Pneumatic reel clamping and automatic unload-position reel delivery . . . can be arranged for end-out winding . . . adaptable to most existing drawing equipment.

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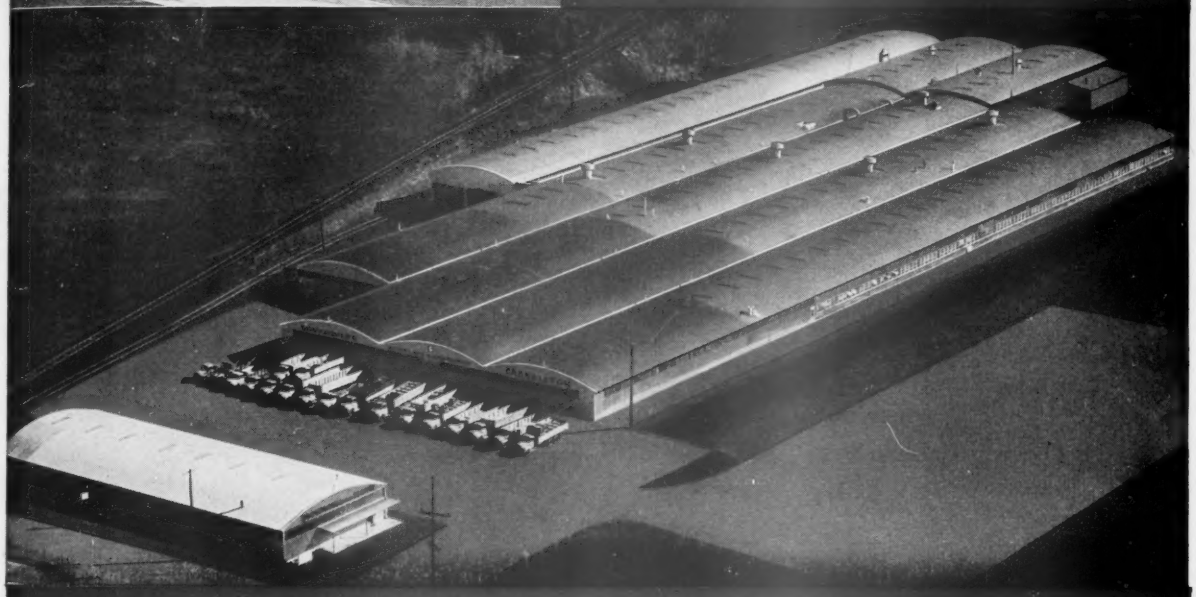
THEN .. and NOW

Since 1950, Southwire has grown from 10,000 to 250,000 square feet—an independent wire and cable manufacturer with skilled manpower to match the most modern equipment available.



SOME THINGS NEVER CHANGE AT SOUTHWIRE

Sure, a fellow may have to walk a little farther from his car to the plant, or use the telephone to get information instead of stepping into the next office for it — but at heart we're still a small plant in a small town, waiting anxiously for each order and eagerly watching its progress through the mill with care and pride.

We're still Jim, and Jack, and Dave, and Pete—to our customers and to each other. The order for a thousand pounds of copper wire is still important to us. And it gets the same personal attention as one for a million and a half pounds of ACSR transmission cable.

True, constantly expanding product lines, larger and more modern facilities, and continuing research programs, are added reasons for doing business with SOUTHWIRE . . . but personal attention, dependable service, and quality products, are the things that have built our business and will continue to make SOUTHWIRE a good place to trade.

SOUTHWIRE serves the world

Southwire® Company

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ALSO FABRICATORS OF COPPER AND ALUMINUM FOR WIRE AND CABLE MANUFACTURERS

CRAFTSMANSHIP

...a matter of tradition!

In New England, in the 17th Century, ownership of silver coin that was lost or stolen was difficult to establish. This led to the need for the silversmith, who melted, forged and hammered the coins into useful objects — upon which he struck a mark or initials for proper identification.

Silver teapot by Paul Revere —now shown at Metropolitan Museum of Art, New York. Photo "Bettman Archive".

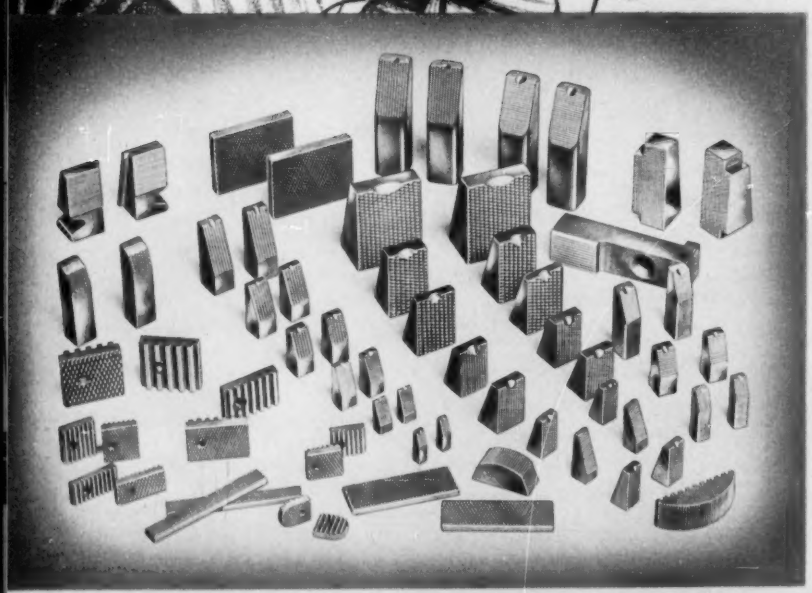
Boston became the home of scores of hard working craftsmen in silver, who, under the apprenticeship system, maintained high standards of skill in designing, working and engraving this precious metal.

Examples of the creative and artistic ability of these silversmiths are in existence today — proof of the craftsmanship of such New Englanders as Paul Revere, John Hull, John Coney and Edward Winslow. They produced spoons, forks, butterdishes, beakers, flagons, salt shakers, coffee pots, tea services, pitchers, sugar and cream sets etc. . . . now preserved as objects of art.

•

New England pride in workmanship has been handed down through the years to other artisans and is evident even in these days of mass production.

Sjogren preserves this principle of craftsmanship . . . maintains this tradition for high quality in the manufacture of wire mill equipment . . . from Sjogren Jaws to custom-built machinery for "wire men who want the best".



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. . . for Wedge Grips, Pullers and Tensile Testing Machines of all makes . . . available from stock or manufactured to order.

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WIRE AND WIRE PRODUCTS*

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 34 October, 1959 No. 10

Designated as Official Publication By The Wire Association

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There is no need to settle for less when buying wire cutting tools.

CAREW cutters have given constant quality unequaled in 89 years.

MADE IN 4 SIZES 8", 10", 12", 14"

Jaws are made of hardened tool steel and are replaceable.

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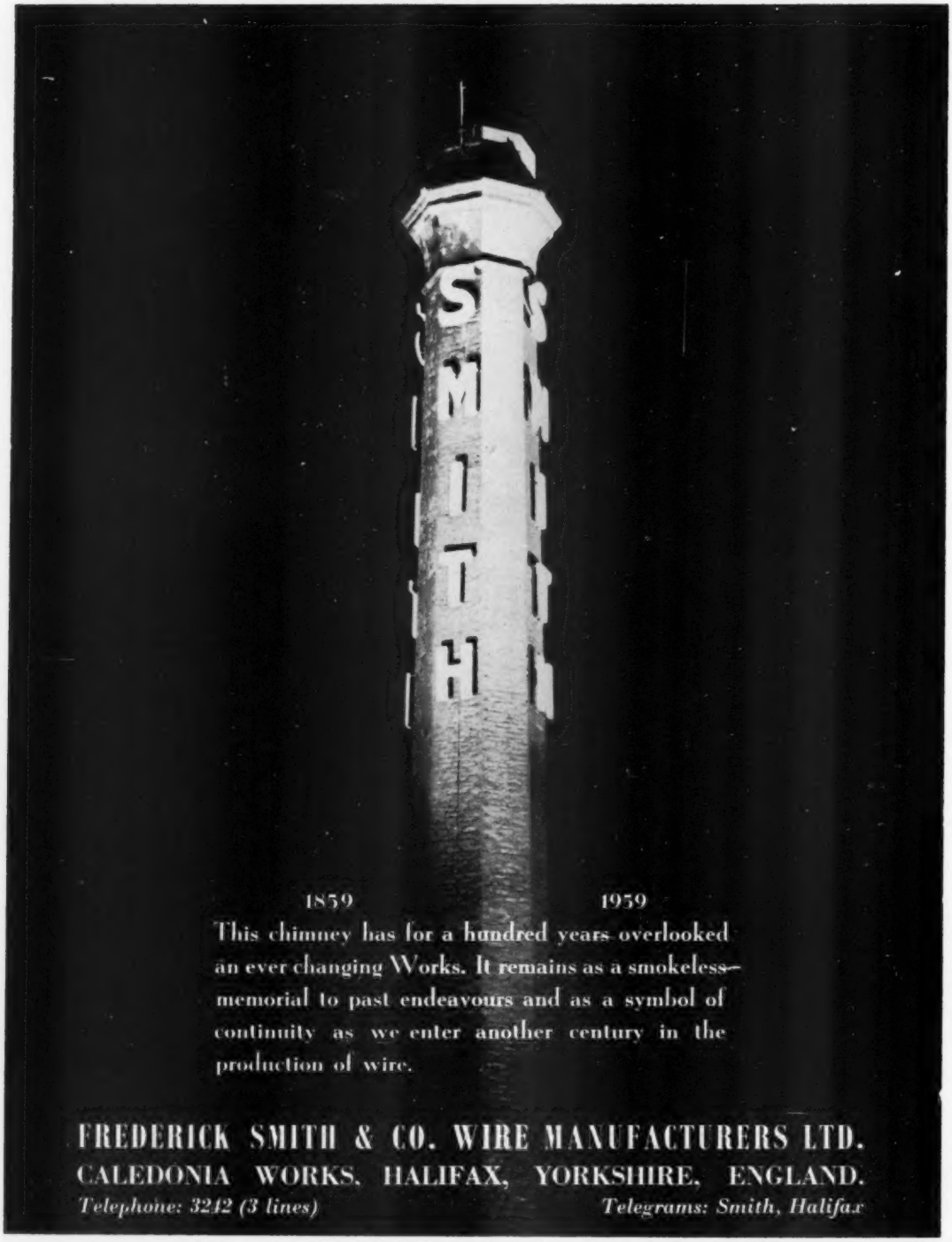

1859 1959

This chimney has for a hundred years overlooked an ever changing Works. It remains as a smokeless memorial to past endeavours and as a symbol of continuity as we enter another century in the production of wire.

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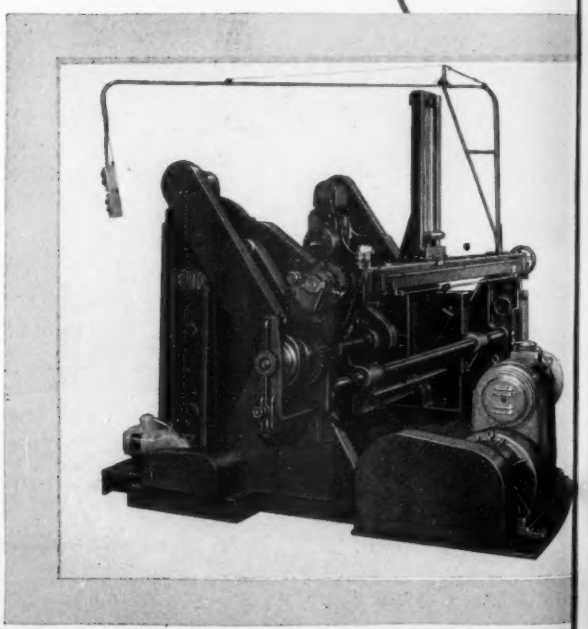
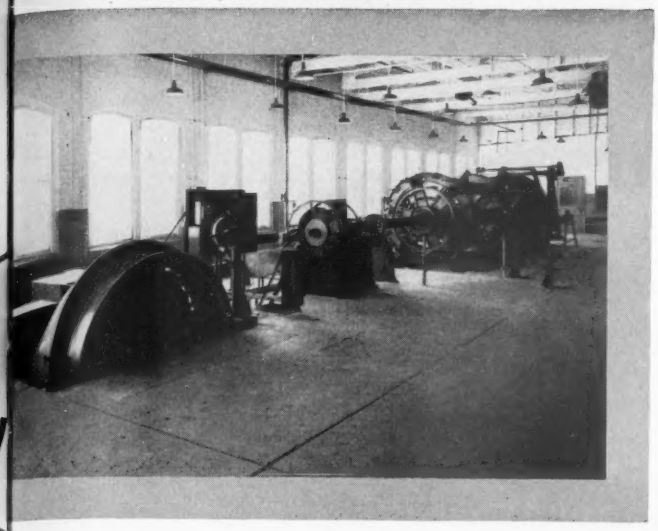
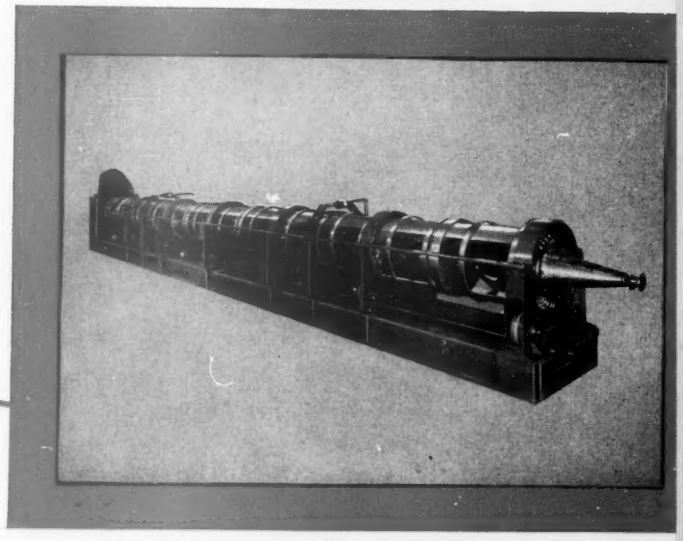


96" Shaftless Take-Up. Guard removed to show drive

7-strand Planetary Closer, for 60" x 48" reel



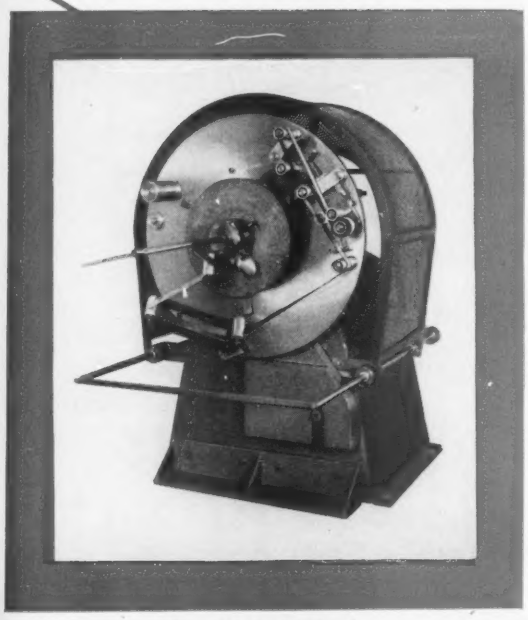
12-Wire Tube Strander



production

insulation

Eccentric Taping Head



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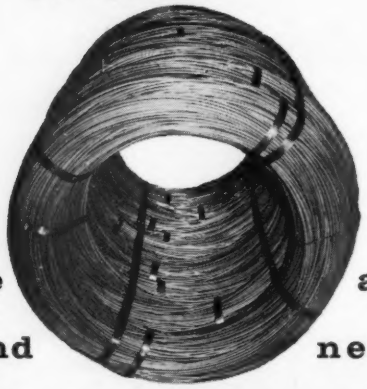

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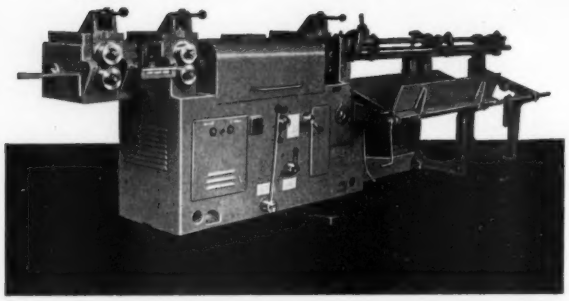

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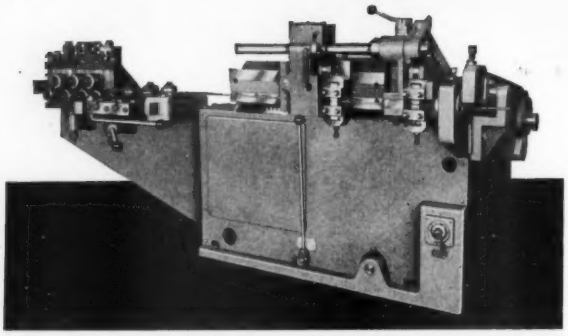

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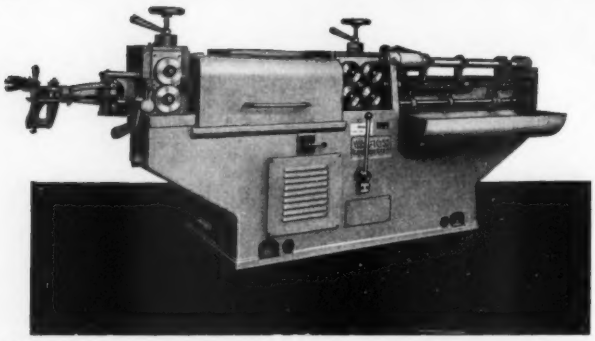

3

4

STRAIGHTENING AND

CUT-OFF MACHINES

standard machines with fixed shear in 6 sizes for wire diameters from .020" to .640"

1 High speed machines with fixed shear in 3 sizes for wire diameters from .060" to .520", with flying shear in 6 sizes for wire diameters from .0395" to 1"

2 For profile wires in 4 sizes with a cross-section equal to round wire diameters ranging from .060" to .640"

3 For electrodes and welding wire of all types in 2 sizes for wire diameters ranging from .079" to .275"

4 For rods and re-inforcing wire with rotating flyers, or roller straightener for wire diameters ranging from .100" to .475"

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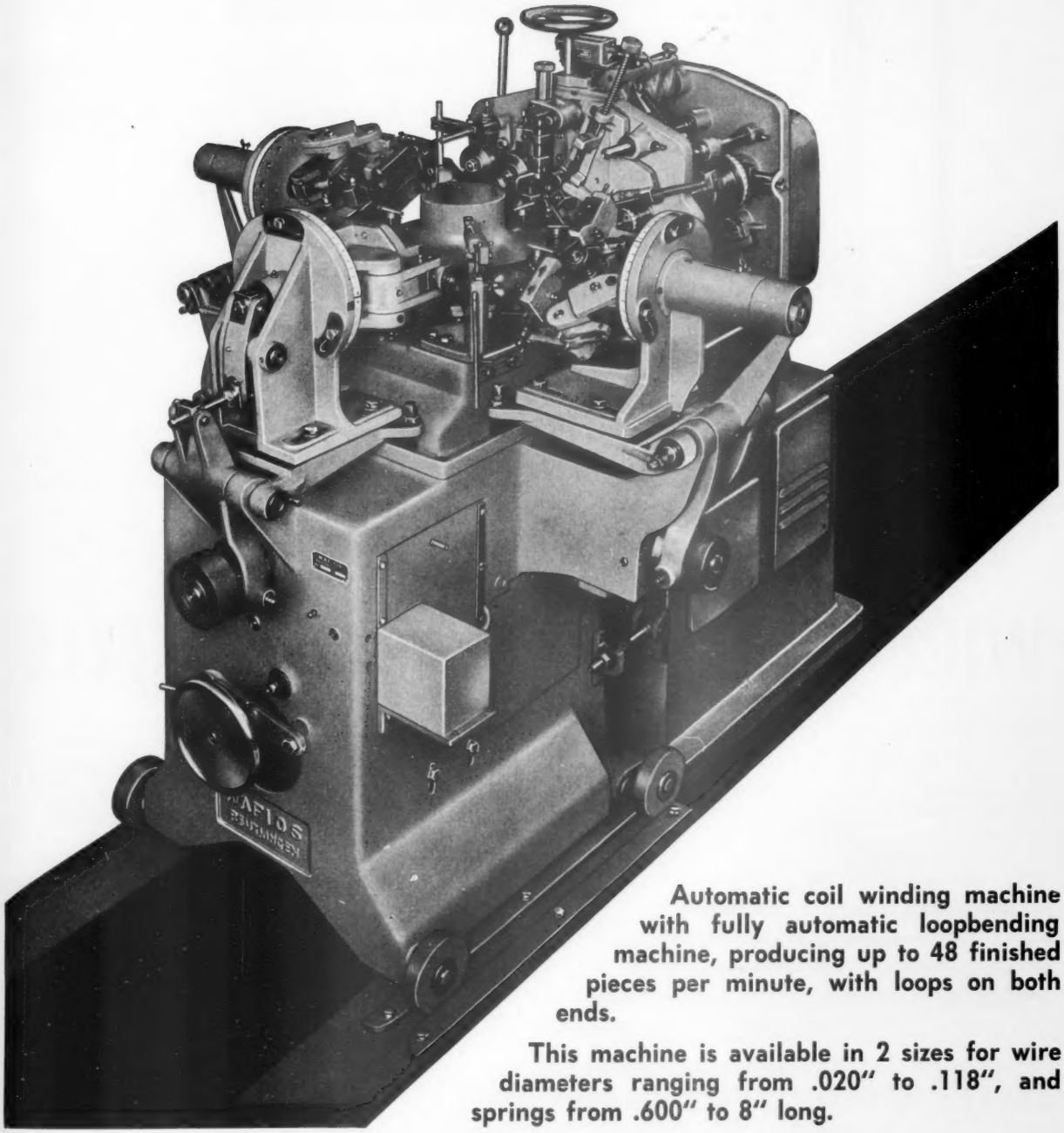
WAGNER, FICKER & SCHMID **REUTLINGEN/WURTT., GERMANY**



Automatic coil winding machine with fully automatic loopbending machine, producing up to 48 finished pieces per minute, with loops on both ends.

This machine is available in 2 sizes for wire diameters ranging from .020" to .118", and springs from .600" to 8" long.

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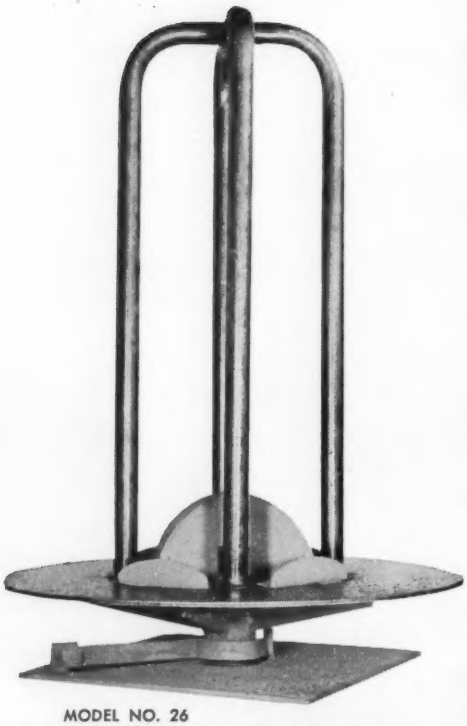


MODEL NO. 26
WIRE CARRIER MOUNTED ON PAY-OFF REEL

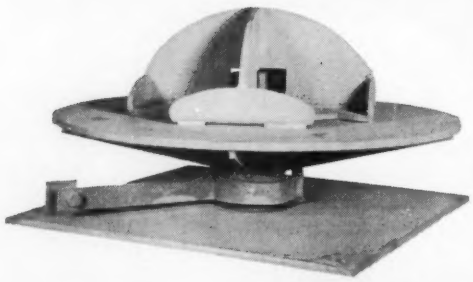
WORKING WONDERS WITH WIRE:

How to reduce changeovers, handling, down-time, scrap-ends 4 to 10 times!

Leading wire producers and fabricators across the country use (and recommend)

NORTHERN INDIANA STEEL'S
HIGH CAPACITY, HEAVY DUTY

WIRE CARRIERS and PAY-OFF REELS



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Let us know exactly what your operating needs are. If we don't already have the wire carriers and pay-off reels in stock, we're ready to make up your order as per your exact specification. In any case, we'll be pleased to quote you promptly in the quantities you specify.

They feed more smoothly

Handle 2000# to 4000# coils

Stack and store easily

And—They're Designed and Produced To *Your* Specifications

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Fabricating Division, Michigan City, Indiana
TELEPHONE TRiangle 4-3241

Progressive Brite Wire Fabricators

report their savings and related benefits after switching from traditional short-run bundles to

DSC–Portsmouth Long Production Run LPR COILS

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• • • Downtime frequency due to coil changes and setup adjustments decreased 50% to as much as 92.8%.

• • • Cumulative coil remnant scrap trimmed to the bone.

• • • Overall man-hour costs cut 15% to 20%.

• • • Small coil racks obsoleted.

• • • Self-supporting, also possessing greater density (weight per cubic foot), LPR'S reduced storage area requirements, cut unloading time from 15% to 50%, increased all-around efficiency of material handling.

• • • Rid us of the bother and cost of caring for vendors' returnable carriers.

• • • Improved efficiency of our inventory management.

*** Does Macy's tell Gimbel's?**
When manufacturing costs are involved, it is contrary to our customer-relations principles to tell "Gimbel's what "Macy's" is doing, without specific approval. We will, however, arrange to document any of these statements for bona fide Brite Wire users.

FOR THE RECORD—We introduced 1,200 pound Long Production Run Brite Wire coils in 1953. By 1958 we had demonstrated their practicability in weights up to about 4,000 pounds. Since 1957 we have been giving 3,000 pound LPR's the proving-ground treatment in our own Welded Wire Fabric operations . . . with substantial savings in overall handling and production costs . . . *We'll be glad to share our experiences with Brite Wire fabricators. We'll also help you stage conclusive trials on LPR's under your own wireworking conditions. You'll be the judge of their cost-reducing potentials. For more complete information call a DSC Customer "Rep" or write to Box 4308, Room 308, Detroit, Michigan.*

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HR and CR Sheet and Strip . . . . . Flat CR Spring Steel
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Customer "REP" Offices in Principal Cities

Customer Satisfaction–Our No. 1 Job

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ATTENDING THE
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WITH THE EXCLUSIVE HEAVY DUTY
CONVOLUTE DURA CURL RIMS

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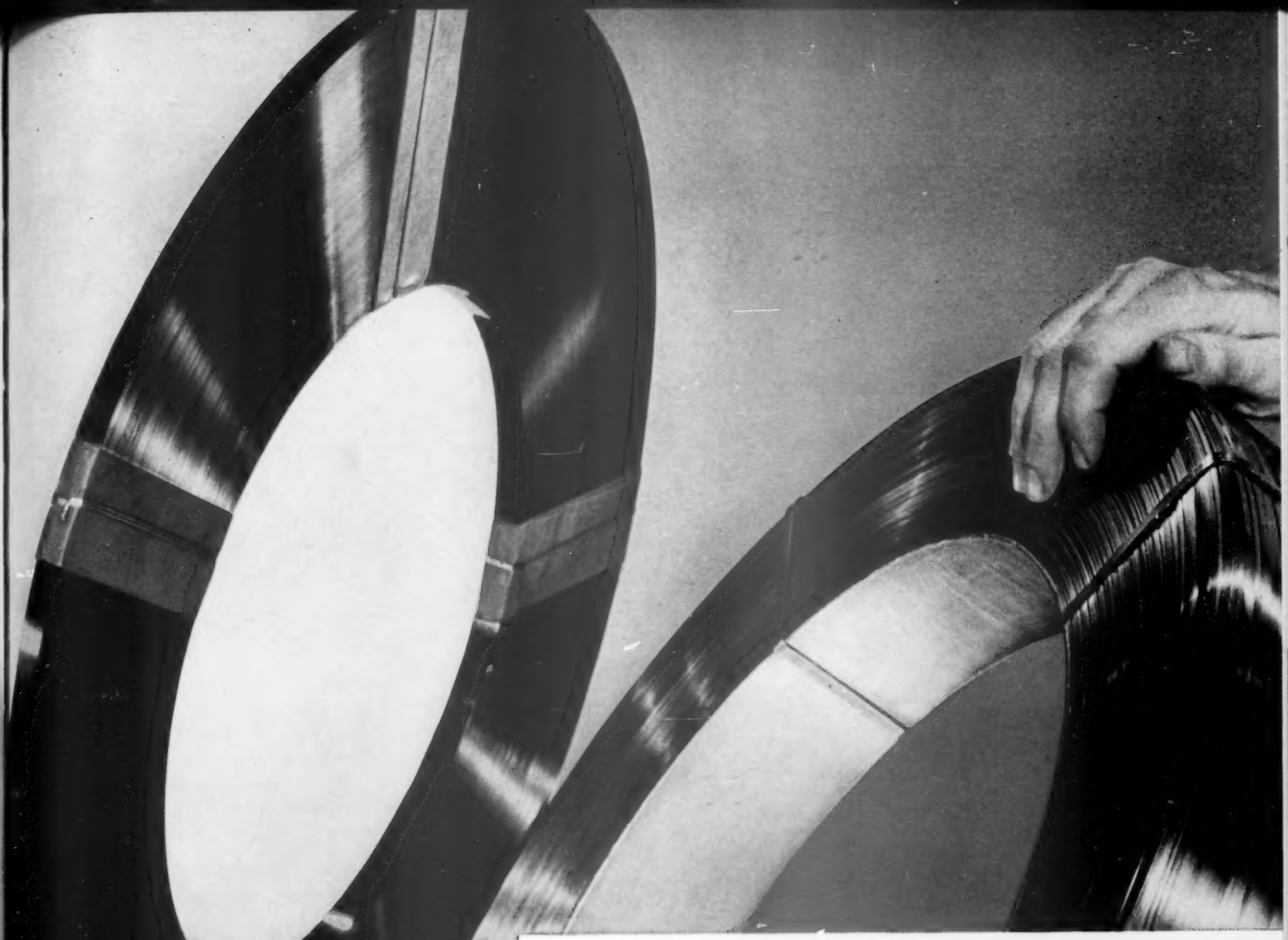
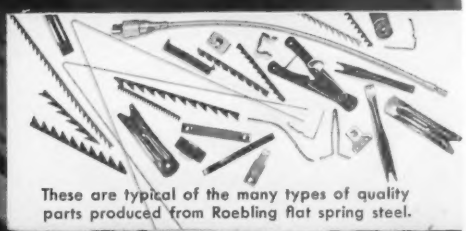


Speaking of Records

. . . *our* records show that when a manufacturer once discovers the exceptional and uniform quality of Roebling flat spring steel, he becomes a permanent Roebling customer.

Your records for faster production and lower costs can be improved, in large measure, by Roebling's strict attention to supplying you with the finest flat spring steel available. When you need flat spring steel, specify Roebling. Write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.



These are typical of the many types of quality parts produced from Roebling flat spring steel.

ROEBLING

Branch Offices in Principal Cities • Subsidiary of The Colorado Fuel and Iron Corporation

Roebling . . . Your Product is Better for it

Talide® Rolls Best for Rolling Ultra-Thin Strip!

Hamilton Watch Company, Lancaster, Pa., leading manufacturer of fine watches and precision instruments, reports superior results obtained using Talide rolls on their ZR-32 4" Sendzimir mill.

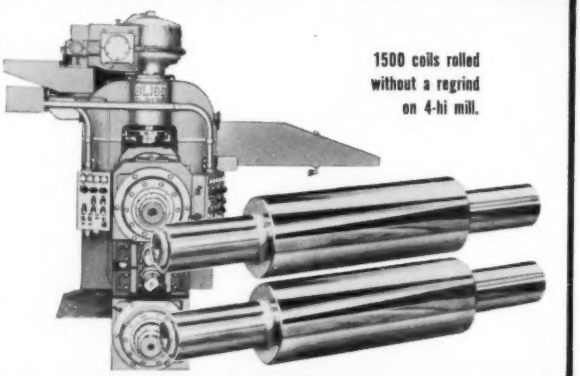
Using Talide rolls, only 1/3 the normal number of passes is required to reduce thickness of ferrous and non-ferrous strip to .000100".

In addition to outwearing steel rolls 4 to 1, grinding costs are reduced and an improved surface finish is imparted to the strip.

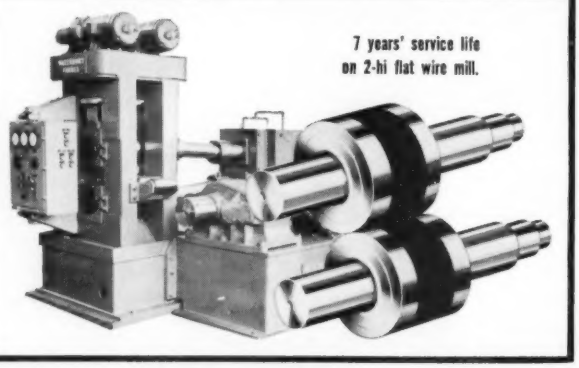
Further, less surface contamination results when using Talide rolls for rolling certain types of alloy strip used for electrical applications.

Talide rolls have proven far superior to both steel rolls and carbide rolls of any other make. They are ultra-hard, extremely dense and porous-free. Strip steel of all analyses can be rolled down to thinner gauge, with more accuracy, greater reductions and with fewer anneals than possible with any other roll.

During the last six years Talide rolls have been adopted by every major strip steel producer. Metal Carbides pioneered and developed tungsten carbide rolls and successfully adapted them to all types of rolling mills including STECKEL, BLISS, UNITED, MESTA, STANAT, SENDZIMIR, WATERBURY-FARREL, TORRINGTON, RUESCH, FENN, WEAN, COLD METAL, etc.



1500 coils rolled without a regrind on 4-hi mill.

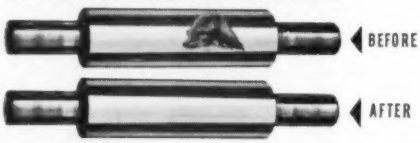


7 years' service life on 2-hi flat wire mill.

ONLY TALIDE WORK ROLLS GUARANTEE THESE ADVANTAGES

- ★ MORE PRODUCTION
- ★ BETTER FINISH
- ★ LONGER LIFE
- ★ HIGHER SPEEDS
- ★ CLOSER TOLERANCE
- ★ IMPROVED PHYSICALS
- ★ GREATER REDUCTION
- ★ LESS DOWN TIME
- ★ FEWER REJECTS
- ★ LESS MAINTENANCE

EXCLUSIVE REPAIR SERVICE



Broken or damaged carbide rolls can be re-worked to first class condition with all defects elminated at one-half original cost. Only Metal Carbides offers this service—because of its exclusive hot press method.

Talide Rolls are made in lengths up to 100", diameters up to 25", and up to 5000 lbs. by weight.

METAL CARBIDES CORPORATION
Youngstown 12, Ohio
Send for new 76-page catalog 56-G

SUPERSET GRINDING WHEEL

The Superset diamond grinding wheel was specially developed for grinding carbide rolls to highest possible surface finish and luster. Made of 4-8 micron size diamond dust, it imparts a surface finish far superior to any other commercial wheel. Available in sizes up to 25" diameter.

METAL CARBIDES CORPORATION
TALIDE®
YOUNGSTOWN 12, OHIO

HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

a Bulletin from

APEX

in one giant stride . . . A MAJOR BREAKTHROUGH IN PVC COMPOUNDS!

This is nothing less than a major breakthrough for PVC compounds. In one giant stride, ***temperature ranges have been extended on both high and low ends.***

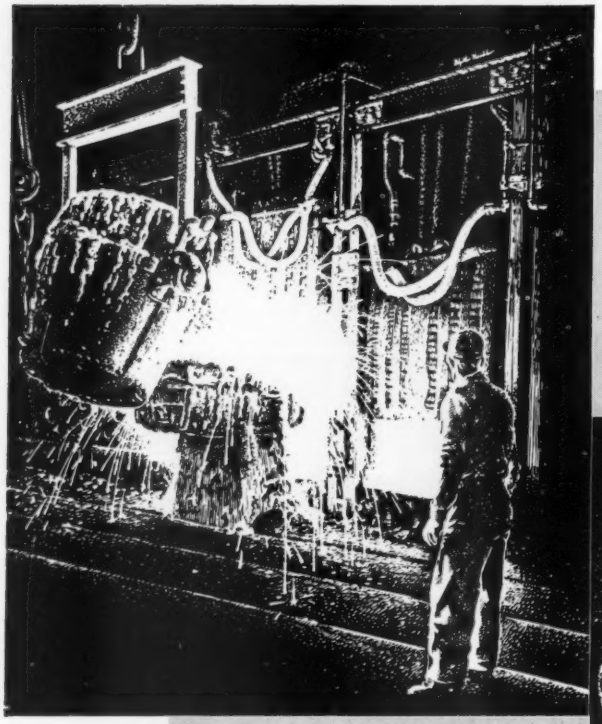
For example, today's best compounds perform well in a temperature range from –40°C to 105°C. Apex "800 series" compounds perform *better* in a range from –54°C to 150°C.

Throughout the entire operable temperature spectrum, each of the new Apex 800 series compounds push back limitations – extending temperatures considerably below and far above previous compounds.

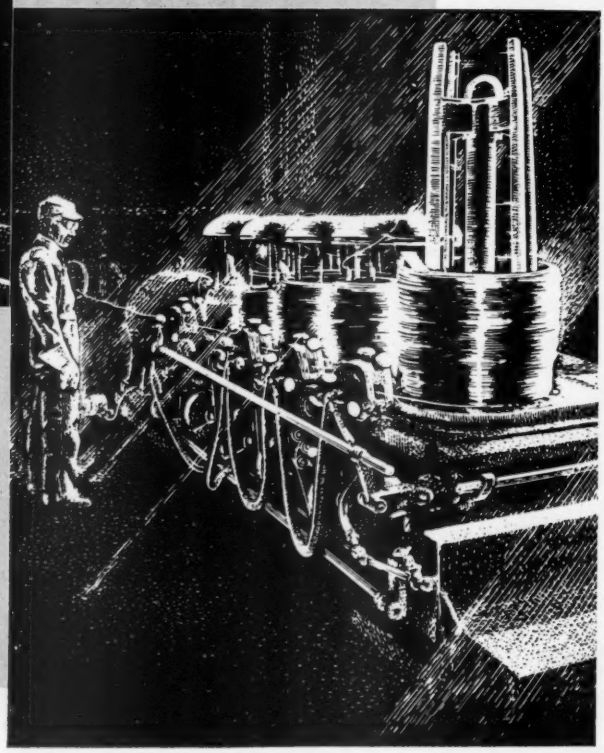
There has been no compromise of other properties to obtain this astonishing improvement in temperature resistances. The new Apex 800 series actually offers improved dielectric strength, greater flexibility, better humidity resistance.

For complete technical data, write today for data sheet number 800.

APEX TIRE & RUBBER CO. Plastics Division **Pawtucket, R. I., U. S. A.**



LACLEDE



Quality Wire... for every need!

A COMPLETE SELECTION—QUALITY CONTROLLED FROM OPEN HEARTH TO DELIVERED PRODUCT

From low carbon wire through medium high carbon wire, MB Grade spring wire, hard drawn, oil tempered and spheroidized, in all sizes, finishes and tempers.

Laclede specializes in metallurgical service that can quickly be of benefit to you and your product.

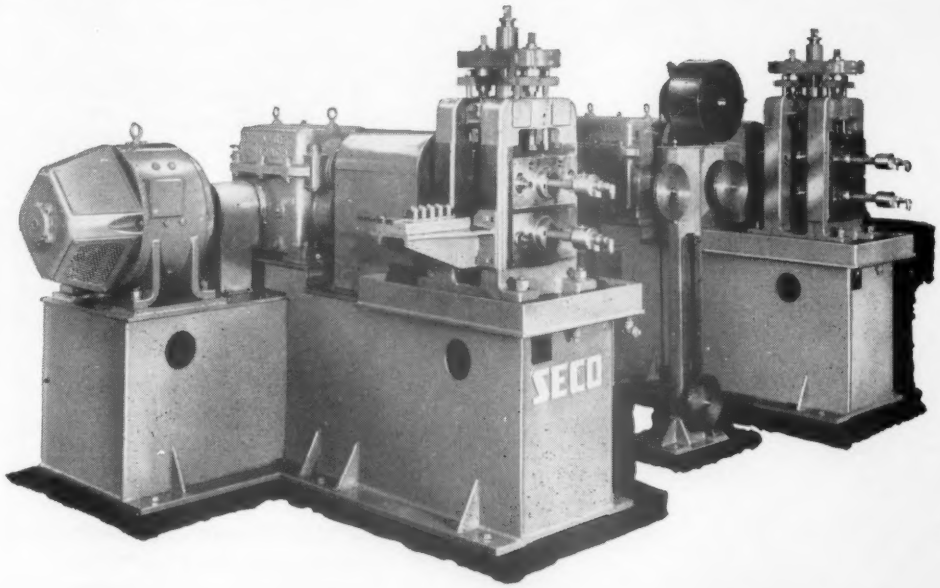
LACLEDE STEEL COMPANY

SAINT LOUIS, MISSOURI

Predictable Performance

is yours when you change to

SECO WIRE FLATTENING MILLS



• Acceptable and predictable performance "on both sides of the fence" when Seco Wire Flattening Mills are used in your operation.

Seco's staff of trained engineers . . . specialists in solving production problems . . . are available for personal assistance to you. Call us today.

SECO

SECO STEEL MILL EQUIPMENT

- Leveling and Shearing Lines
- Combination Edging and Flattening Lines
- Tension Reels for Strip Polishers
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- Multiple Strand Pull-out Rolls and Take-up Frames
- Strip Coilers (Up and Down Type)
- Traverse Reels for Narrow Strip
- Steel Coil Up-enders
- Scrap Ballers

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P. O. BOX 737, WARRENSVILLE STATION • CLEVELAND 22, OHIO

AFFILIATED WITH *Lee Wilson* ENGINEERING CO., INC.

LOW COST precision wire plating

UNIFORM COATINGS MAINTAINED AT HIGH SPEEDS

CONTINUOUS
ELECTROPLATING
EQUIPMENT

This low cost equipment performs with such ease and efficiency that it means real savings for you. Preset quality control insures perfection without depending on operators' skill. No toxic fumes, clean operation at low temperature, elimination of work hardening during processing, and many other features are the result of experience and sound engineering that go into the design of all Universal equipment.

We furnish complete installation . . .
For further information write to:

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SOLE AGENT IN CANADA: E. V. LARSON CO., LTD., TORONTO, CANADA

U. S. PATENT #2823180 AND FOREIGN PATENTS PENDING

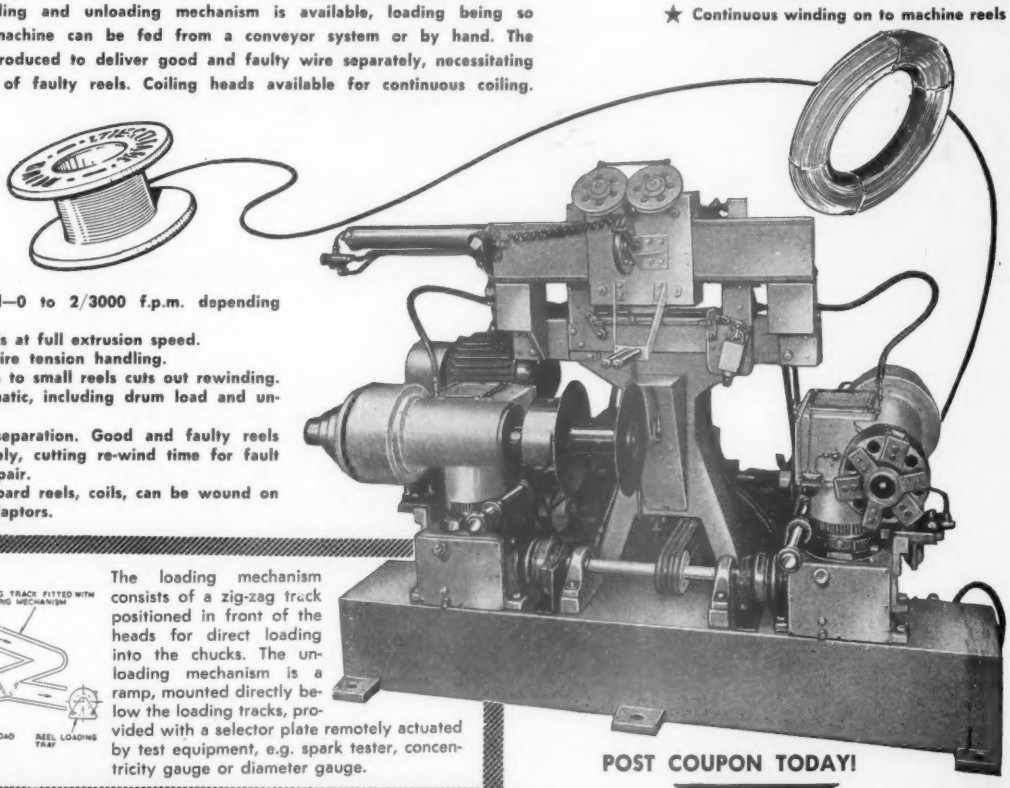
CABLE REELING REVOLUTIONISED!

NEW GENERAL TYPE TA 15 FULLY AUTOMATIC DUAL-REEL TAKE UP.

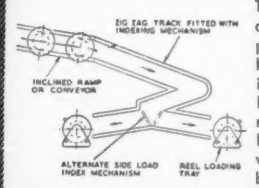
(PATENTS APPLIED FOR IN GREAT BRITAIN AND COUNTRIES ABROAD)

Here is an entirely automatic cable and wire reeling machine specially designed for reeling direct on to small diameter steel or despatch reels—entirely eliminating the operations of rewinding from large to small reels. Suitable for any continuous process, e.g. wire drawing, extruding or continuous vulcanising. 2½ lbs. operates accumulator. Reel speeds up to 2450 r.p.m. 4:1 reel build-up readily handled. A fully automatic loading and unloading mechanism is available, loading being so arranged that the machine can be fed from a conveyor system or by hand. The unloading unit is introduced to deliver good and faulty wire separately, necessitating only the rewinding of faulty reels. Coiling heads available for continuous coiling.

- ★ Continuous coiling
- ★ Continuous winding on to despatch reels
- ★ Continuous winding on to machine reels



- ★ High wire speed—0 to 2/3000 f.p.m. depending on reel size.
- ★ Wire changes reels at full extrusion speed.
- ★ Low controlled wire tension handling.
- ★ Direct winding on to small reels cuts out rewinding.
- ★ Completely automatic, including drum load and unload if required.
- ★ Automatic fault separation. Good and faulty reels delivered separately, cutting re-wind time for fault relocation and repair.
- ★ Steel reels, cardboard reels, coils, can be wound on different chuck adaptors.


ZIG ZAG TRACK FITTED WITH INDEXING MECHANISM
INCLINED RAMP OR CONVEYOR
ALTERNATE SIDE LOAD INDEX MECHANISM
REEL LOADING TRAY

The loading mechanism consists of a zig-zag track positioned in front of the heads for direct loading into the chucks. The unloading mechanism is a ramp, mounted directly below the loading tracks, provided with a selector plate remotely actuated by test equipment, e.g. spark tester, concentricity gauge or diameter gauge.

POST COUPON TODAY!

GENERAL ENGINEERING CO (RADCLIFFE) LTD

MAKERS OF COMPLETE EXTRUSION LINES AND CABLE PROCESSING PLANT

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Telephone: RADcliffe 2291 (4 lines) Telegrams: "General," Radcliffe, Manchester.

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Please send Bulletin T.A. 15 for Fully Automatic Patented Dual reel Take-up.

Name .....

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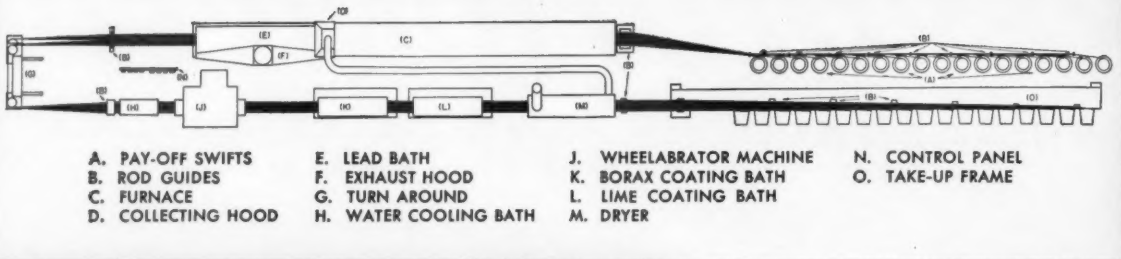
A NEW TWIST TO WIRE MAKING



A. PAY-OFF SWIFTS
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C. FURNACE
D. COLLECTING HOOD
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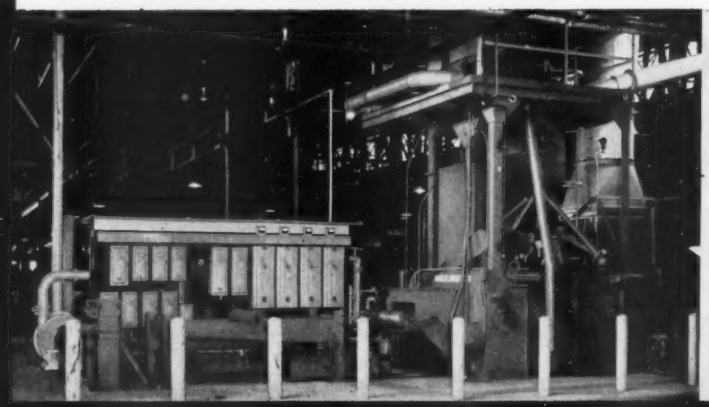
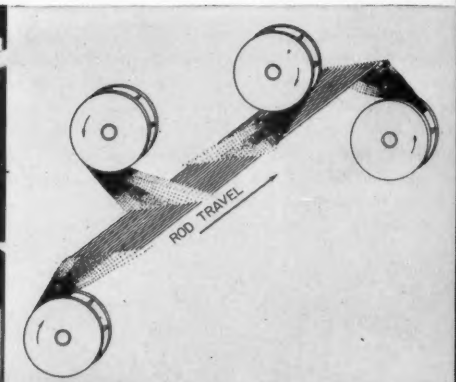
F. EXHAUST HOOD
G. TURN AROUND
H. WATER COOLING BATH
J. WHEELABRATOR MACHINE
K. BORAX COATING BATH
L. LIME COATING BATH
M. DRYER
N. CONTROL PANEL
O. TAKE-UP FRAME





ROEBLING continuous wire production based on WHEELABRATOR® blast cleaning

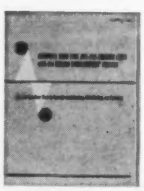
Continuous patenting, cleaning and coating of steel wire adds up to more efficient operation at lower cost, for John A. Roebling's Sons Corp.

The new processing line, installed at the Roebling mill, incorporates Wheelabrator airless blast cleaning as a key step in the operation. Wire now is patented and cleaned in one continuous operation, with a resultant decrease in labor cost.

Eighteen strands of steel wire pass simultaneously through the muffle furnace, lead quenching bath, Wheelabrator blast cleaning machine, coating baths, drying ovens, and thence to the take-up frame, in a compact operation occupying an area of 250 ft. long and 30 ft. wide. Normal production rate is about 6,000 pounds per hour. Speeds through the blast cleaning unit vary with the gauge of wire, with .250" diameter rod running at 34 fpm.

Wheelabrator mechanical cleaning eliminates the costly problems of acid disposal, and maintenance of acid pickling equipment. By promoting efficient "straight-line" production, it minimizes handling costs. The combined effect of cleaning and labor savings is a considerable reduction in the patenting and cleaning cost.

Write for Bulletin 148-D, illustrating use of the Wheelabrator process for producing finished wire from hot rolled rod in one continuous operation.

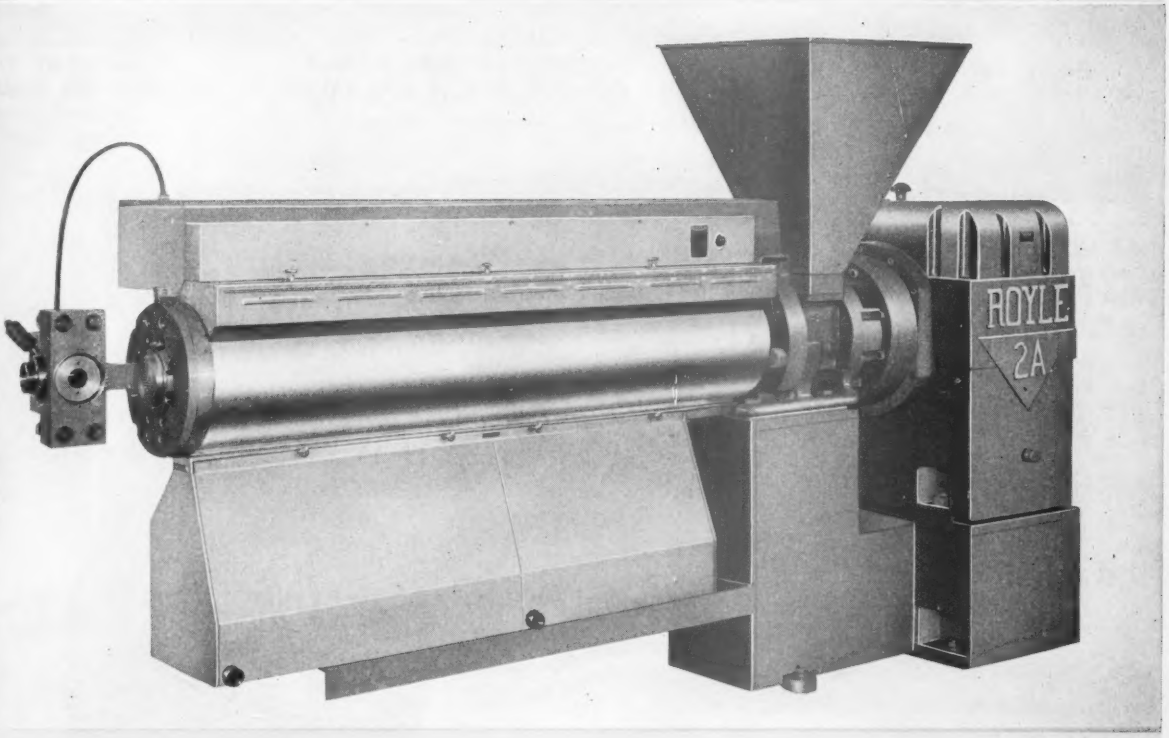


WHEELABRATOR
CORPORATION
389 South Byrkit Street Mishawaka, Indiana
Canadian Division: Box 490, Scarborough, Ontario

WORLD'S LARGEST MANUFACTURERS OF AIRLESS BLAST CLEANING EQUIPMENT AND STEEL ABRASIVES

Royle brings you

FASTER PRODUCTION WITH LESS WASTE



Royle Spirod Extruders are expressly designed for high speed Vinyl Extrusions. At the same time, they assure you quality controlled production not before obtainable.

The engineering advances that bring you these benefits are exclusively Royle's: high output at high stock screw speeds, due to longer length to diameter ratios; and extremely efficient evaporative cooling.

Longer L/D screws provide greater plasticizing ability, while evaporative cooling at any point on the cylinder removes the excess frictional heat generally associated with high stock screw speeds.

As they have been since 1880,
Royle is first in Extruder development.

ROYLE
Paterson, N. J.

JOHN ROYLE & SONS

Pioneered the Continuous Extrusion Process in 1880

London, England, James Day (Machinery) Ltd., Hyde Park 2430-0456. **Home Office,** V. M. Hovey, J. W. VanRiper, SHerwood 2-8262. **Akron, Ohio,** J. C. Clinefelter Co., BLackstone 3-9222. **Downey, Cal.,** H. M. Royal, Inc., TOpaz 1-0371. **Tokyo, Japan,** Okura Trading Company, Ltd., (56) 2130-2149.

John Royle & Sons, 10 Essex Street, Paterson 3, N. J.

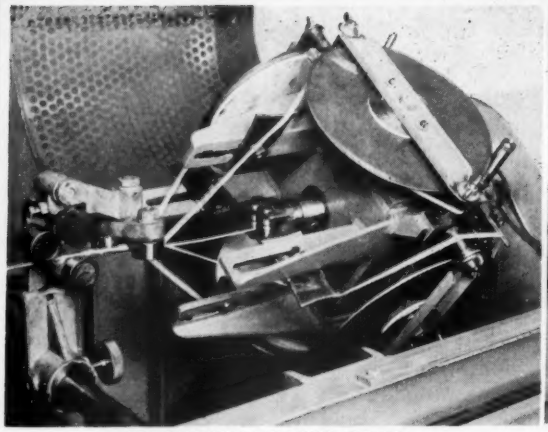
Please, send me full information about Royle High Speed Vinyl Extruders.

Name_____ Title_____

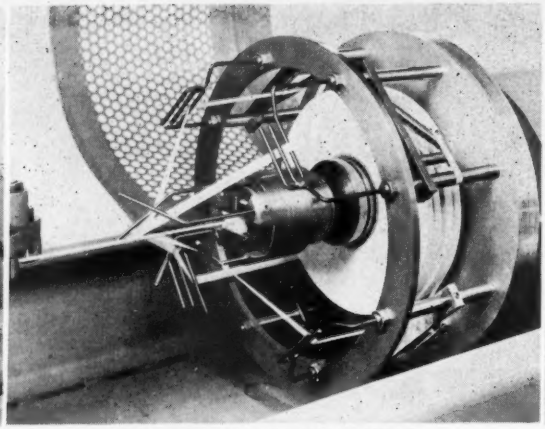
Company_____

Street_____

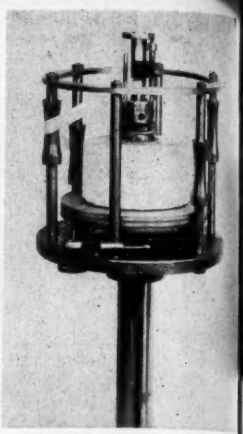
City_____ Zone____ State_____



ECCENTRIC TAPING HEAD
NO. 889 (2, 3 & 4 TAPES)

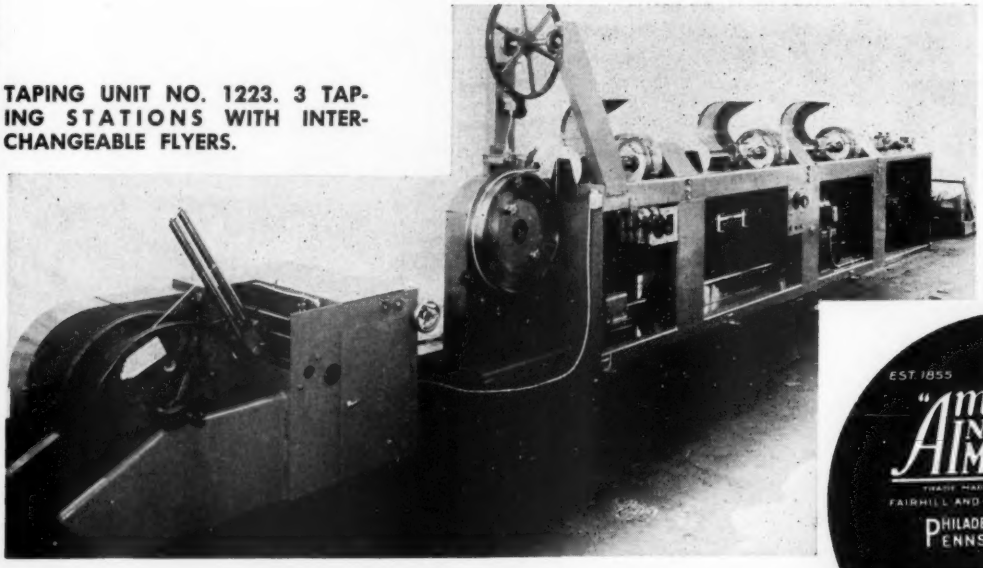


CONCENTRIC TAPING HEAD
NO. 1231 (1, 2, 3 or 4 TAPES)

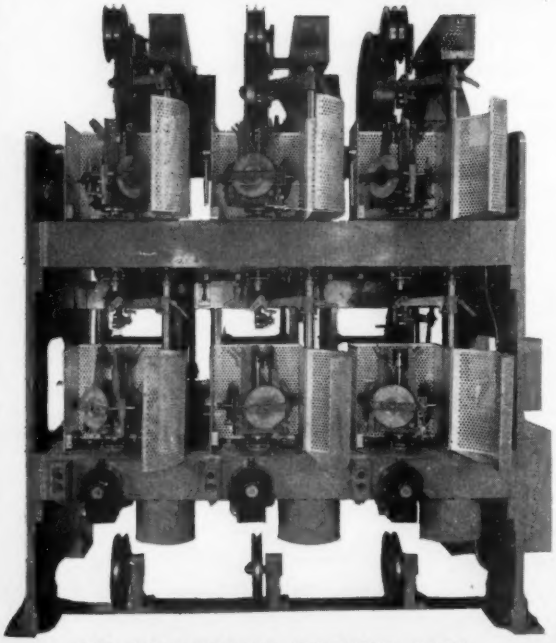


CONCENTRIC TAPING HEAD FOR UNIVERSAL WOUND COPS
No. 1147.

TAPING UNIT NO. 1223. 3 TAPING STATIONS WITH INTERCHANGEABLE FLYERS.

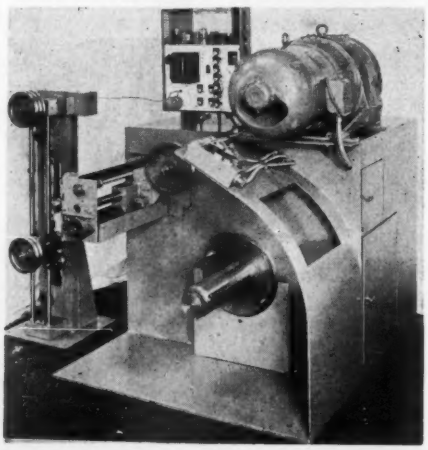


EST. 1855 AIMCO INC. 1915
"American" INSULATING MACHINERY COMPANY
TRADE MARK
FAIRHILL AND HUNTINGDON STREETS
PHILADELPHIA 33 PENNSYLVANIA U.S.A.
MANUFACTURERS OF WIRE INSULATING MACHINERY AND ALLIED EQUIPMENT. MACHINERY MFG. TO CUSTOMERS SPECIFICATIONS.

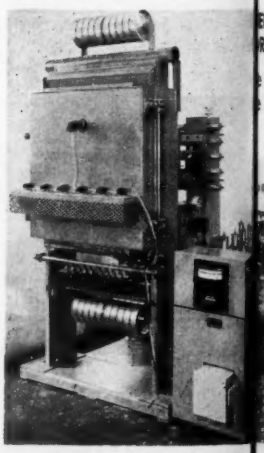


NO. 3-D-3 TAPING MACHINE, EACH TAKING 3 PAD ECCENTRIC TYPE FLYER.

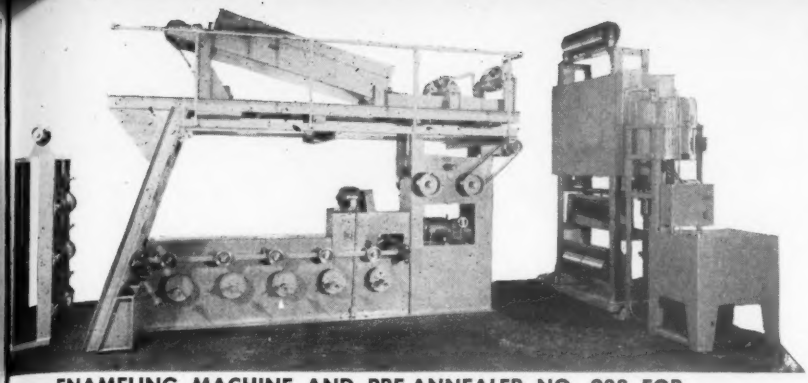
HEAVY TAKE-UP NO. 1234, BEHIND WIRE DRAWING AND TINNING.



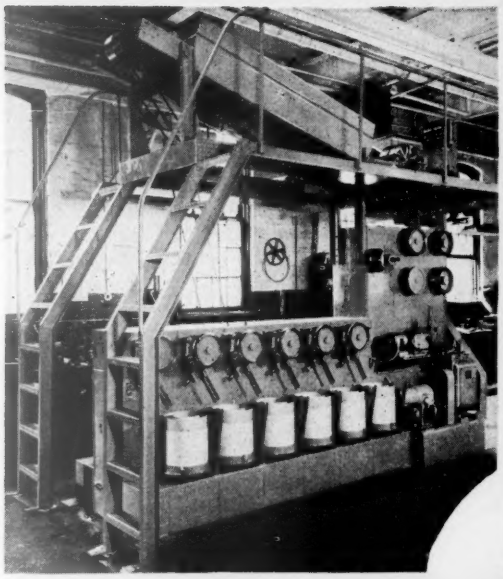
M-10 ENAMELING MACHINE NO. 1220 FOR FINE WIRES, 36 AND FINER.



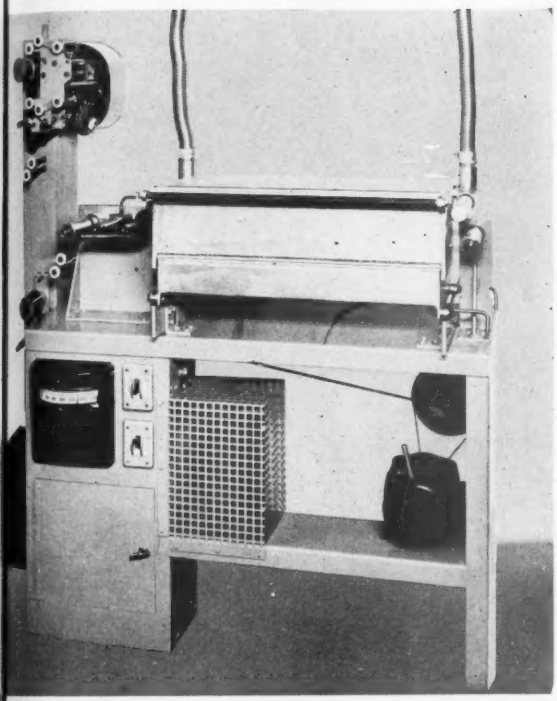
AMERICAN INSULATING MACHINERY COMPANY
FAIRHILL AND HUNTINGDON STREETS PHILADELPHIA 33, PENNSYLVANIA, U.S.A.



ENAMELING MACHINE AND PRE-ANNEALER NO. 988 FOR REEL TAKE-UP. B&S GAUGE 20 TO 30.



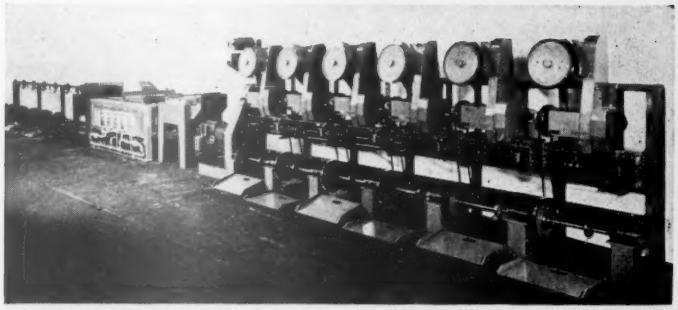
NO. 1237. SAME AS ABOVE FOR BARRELL TAKE-UP, B&S GAUGE 20 TO 30.



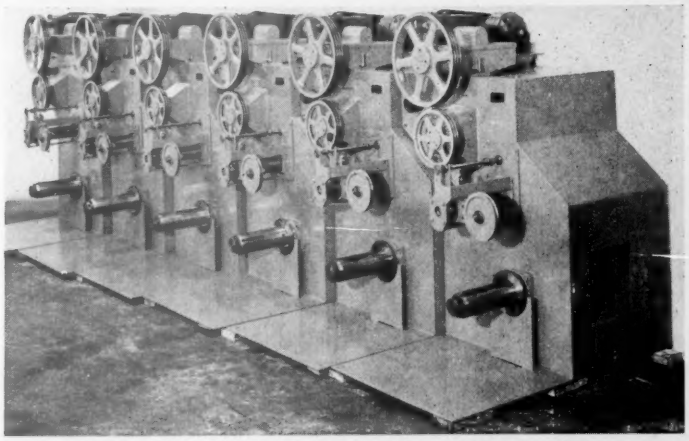
ORIZONTAL FINE WIRE NAMELING MACHINE No. 1247

EEDS 50-200 F.P.M. — WIRE SIZES DOWN TO .0005 R ALLOY WIRES — EASY STRING UP

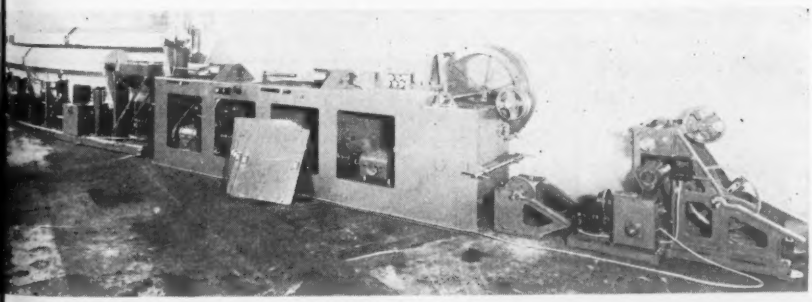
e manufacture a full line of enameling machines from e heaviest flat wires to the smallest diameters.



HEAVY WIRE TINNING OUTFIT NO. 1010 WITH GAS HEATED TINNING TANK AND AUTOMATIC HEAT CONTROL.



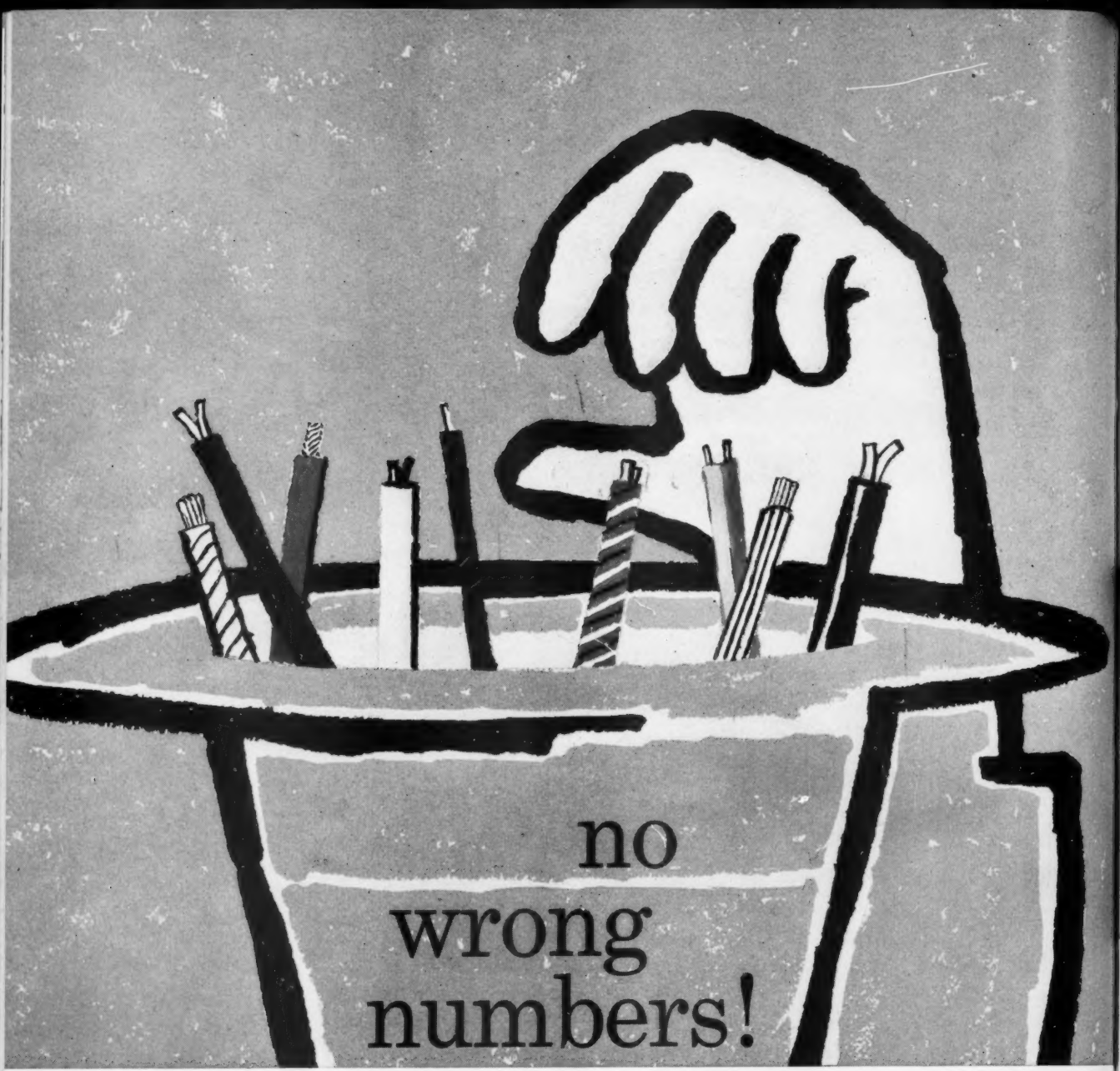
MULTIPLE WIRE TAKE-UP NO. 1049, 6 INDIVIDUAL UNITS, EACH REEL-ARBOR TORQUE MOTOR DRIVEN. FOR USE IN WIRE TINNING OUTFITS, ETC.



GLASS INSULATION WIRE COVERING MACHINE NO. 805, WITH ELECTRIC HEATED VARNISH BAKING OVEN.

AMERICAN INSULATING MACHINERY COMPANY

FAIRHILL AND HUNTINGDON STREETS PHILADELPHIA 33, PENNSYLVANIA, U.S.A.



MONSANTO POLYETHYLENE formulations are based on long experience in supplying the specialized needs of the Wire and Cable Industry. That's why you can always count on a correct answer to your specific insulation problem, when you call Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

*OPALON: REG. U.S. PAT. OFF.

Monsanto

MPE 10 medium molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone cable, power cable, control cable, and general insulation use.

11302 medium molecular weight black, with non-discoloring antioxident; for line and drop wire insulation, weather-resistant primary and support wire insulation, general purpose jacketing.

12203 high molecular weight natural, with non-discoloring antioxidant; primary insulation for telephone, power, and control cable; insulation requiring superior toughness, maximum stress crack resistance.

12253 medium molecular weight natural, with non-discoloring antioxidant; for primary insulation for coaxial cable, power cable, telephone cable, and general insulation use.

14202 high molecular weight black, with non-discoloring antioxidant; telephone and power cable jacketing; all jacketing and insulating applications requiring maximum stress crack and weather resistance.

Monsanto has also developed a complete line of Opalon* Vinyl compounds for wire and cable insulation.

Are you receiving your monthly "WIRE RECORDER"? Use coupon to get this useful news bulletin published by Monsanto.

Monsanto Chemical Company,
Plastics Division,
Springfield 2, Mass.

Please place my name on your mailing list to receive free monthly copy of "WIRE RECORDER"

NAME_____ TITLE_____

COMPANY_____

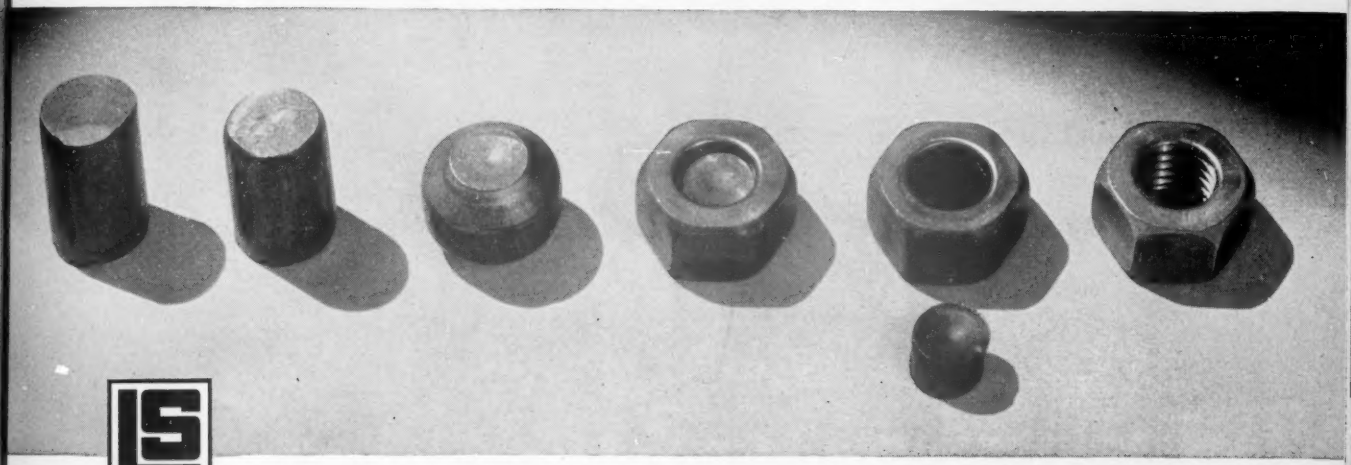
ADDRESS_____

CITY_____ STATE_____

Cold-forged nut machines *at Lamson & Sessions' Kent, Ohio plant thrive on a steady diet of Youngstown Scrapless Nut Quality Rod.*

Accent on Excellence

Youngstown scrapless nut quality rod



George S. Case, Jr., President of Cleveland's Lamson & Sessions Company, recently stated: "Today, as industry moves more and more toward automated or semi-automated production and assembly, *highest quality* and *reliability* of components becomes a *must.*"

To keep their product quality at the highest level, Lamson & Sessions' engineers specify Youngstown's Scrapless Nut Quality Rod for cold forged nuts. This versatile rod feeds smoothly through the cold headers —results in fewer rejects, less downtime and reduced die wear.

Wherever steel becomes a part of things *you* make, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you create products with an "accent on excellence". The Youngstown Sheet and Tube Company, Youngstown, Ohio. Carbon, Alloy and Yoloy Steel.

QUALITY YOUNGSTOWN SERVICE

Youngstown

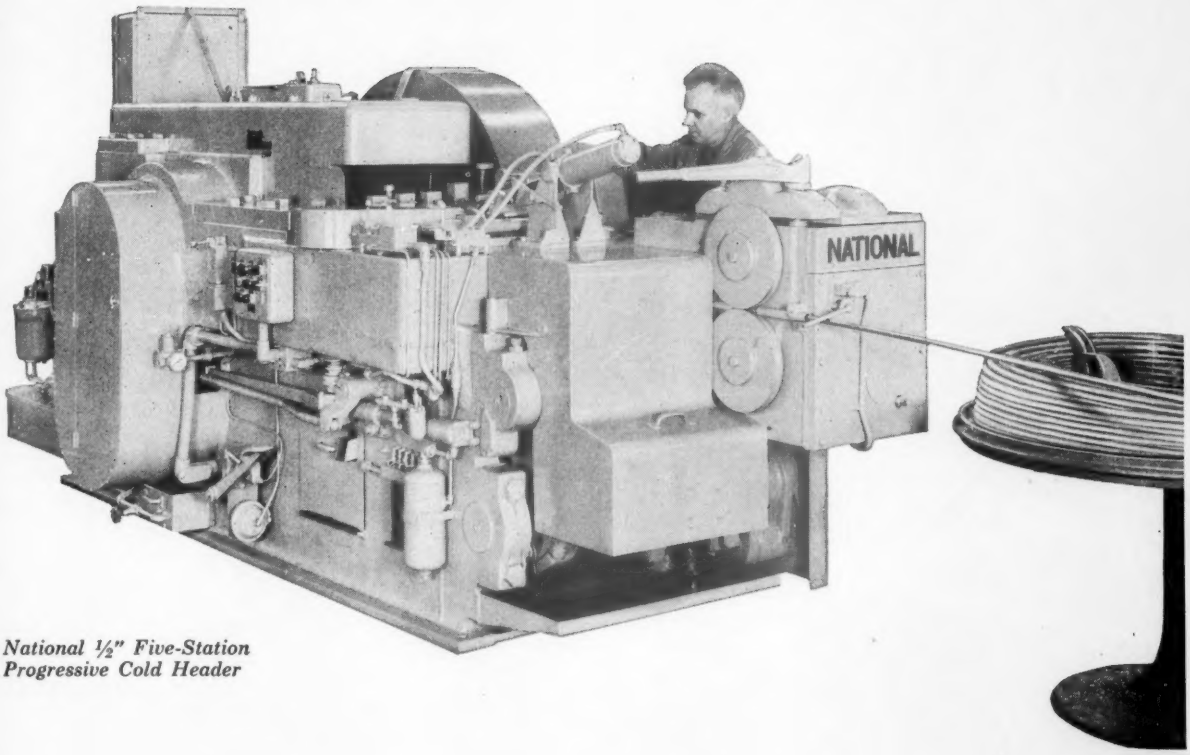
Top row, left to right: piston pin, wheel nut, ball stud, pump shaft, faucet stem.
Middle row: spark plug body, eye bolt, shuttle tip, ball socket, universal joint bearing cup, splined square-head shaft.
Bottom row: tube nut, tappet plunger, hollow rivet, blind rivet, distributor cap insert, commutator bar.

These are typical parts you can make to advantage, not by wasteful cutting, but by *cold heading* — flowing metal into accurate shapes. All of the above jobs, with one exception, were made complete from coiled wire to finished part, without intermediate annealing and coating, *in one compact machine!*

Why are formerly difficult-to-head jobs like these not only possible now, but commercial? The answer is teamwork, on many fronts. For example:

(1) More versatile metals are now available in coiled wire. (2) Die materials and lubricants are still better. (3) We are getting important (to us) but usually insignificant concessions from cold-heading-minded parts designers. (4) National Cold Headers, multiple-die Progressive Headers, Cold Formers

The modern way to make Metal Parts faster, stronger, to amazingly close dimensions!



National ½" Five-Station Progressive Cold Header

and Boltmakers, backed by our fast-growing engineering experience, are now specially equipped to produce reliably the formerly difficult jobs like these shown here.

Are your production problems like these? Perhaps cold heading could pay off for you in a remarkably short time. Let's find out.

Here is our service to metalworking, and you are under no obligation to buy. Send us samples or prints of your jobs. Better yet, bring them to Tiffin where more of our experienced people can participate in *your* problem.

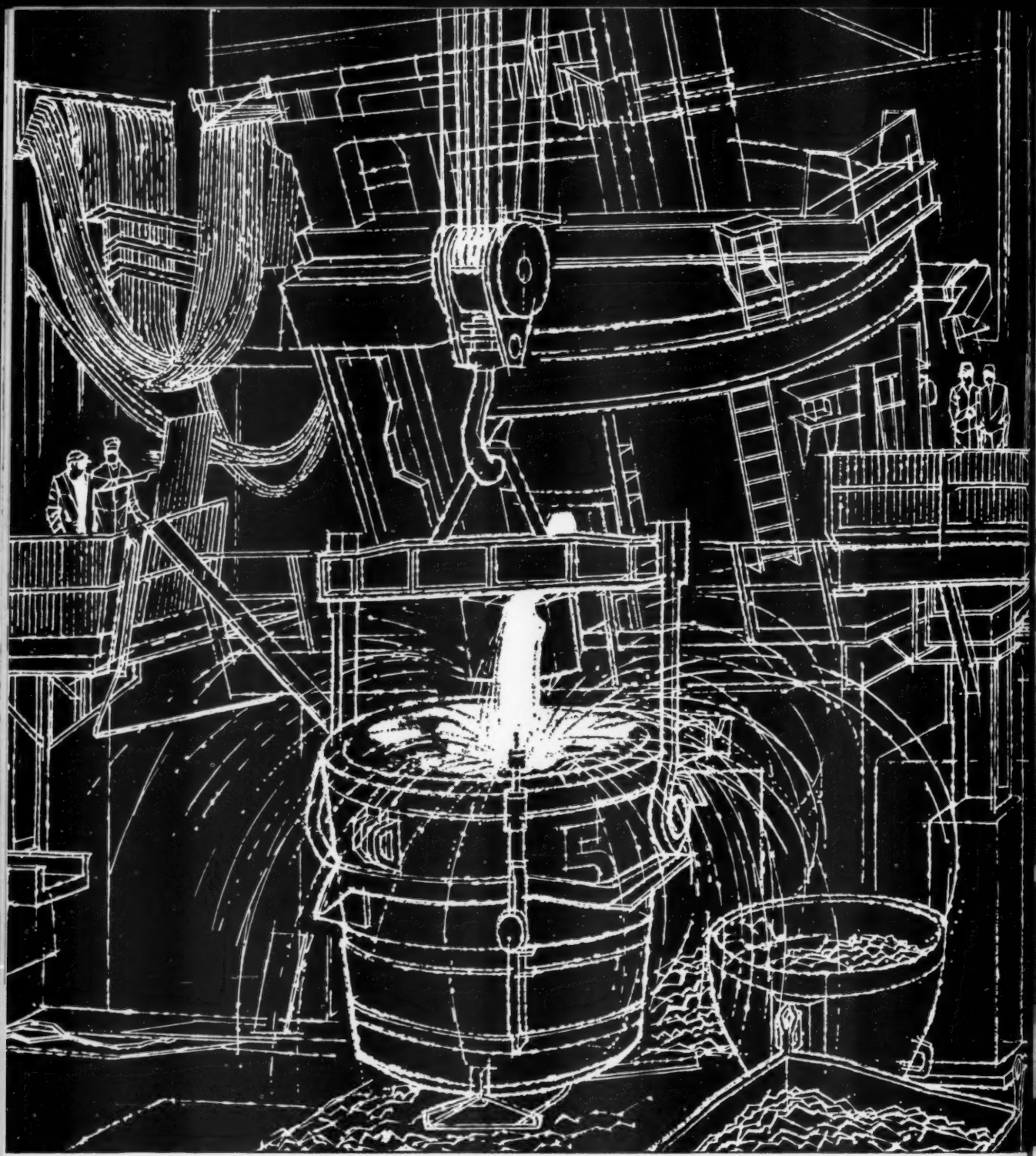
We shall be happy to work with you in developing that better method.

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

HARTFORD DETROIT CHICAGO

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.



Wire Quality Starts Here

Melt shop origin is an infallible guide to **consistent quality** in stainless steel wire.

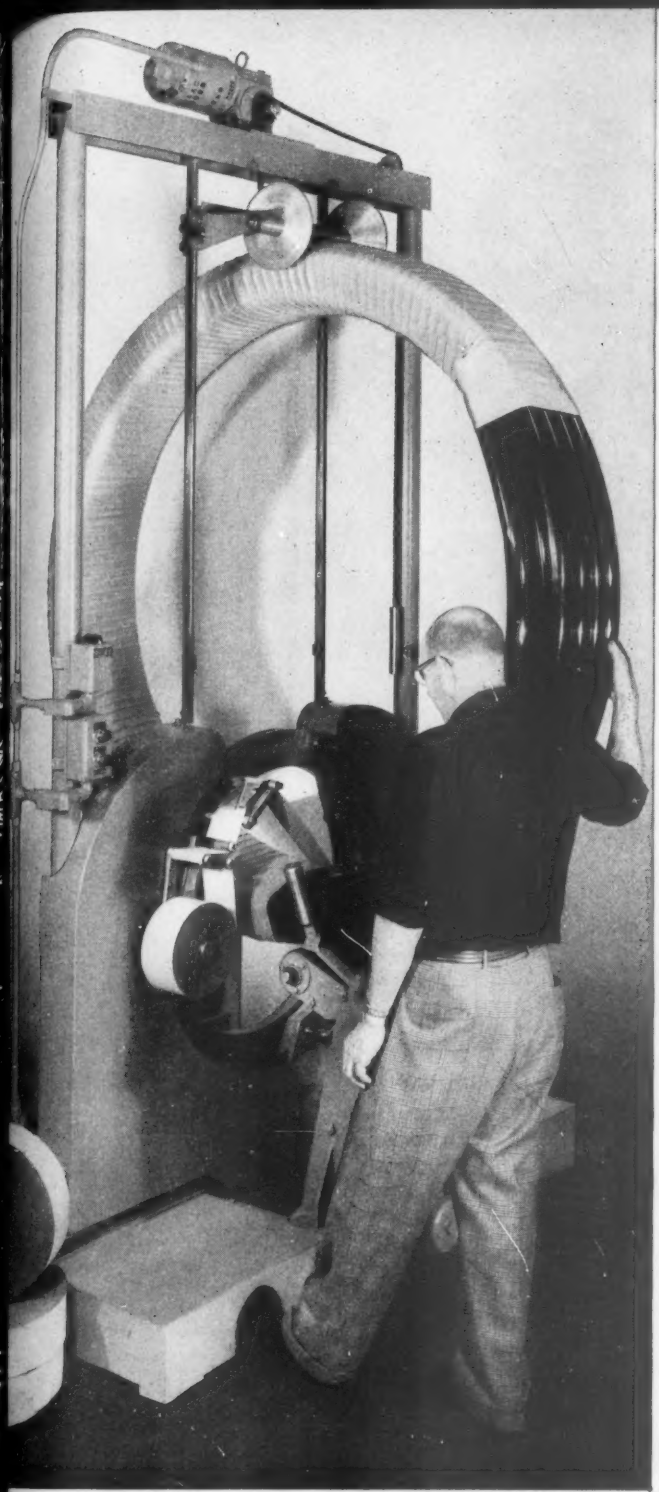
J&L craftsmanship and modern equipment for hot rolling, cold finishing and final processing rely on melt shop quality to **consistently** meet your most exacting specifications.

J&L leads the industry in melt shop standards for stainless steel—the point where consistent quality starts **and better wire products begin.**

J&L
STAINLESS
SHEET • STRIP • BAR • WIRE

Plants and Service Centers:
Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

Jones & Laughlin Steel Corporation • **STAINLESS and STRIP DIVISION** • **Box 4606, Detroit 34**



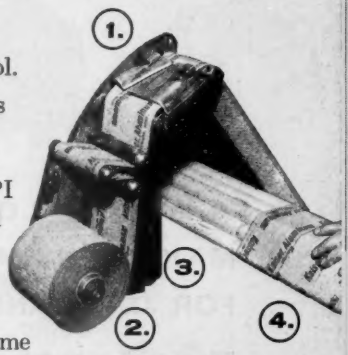
New Spiralwrap Machine Handles Coils up to 107" O.D.

Ludlow's new UW-16 Spiralwrap Machine offers a greater coil size capacity than any other machine of its type. With a coil traverse of 15½", the UW-16 wraps coils from 24" to 107" O.D.

The UW-16 is *custom designed* to meet your exact range requirements. Conformation of the machine to the product is achieved by simply "dialing" the coil specifications.

Bottom-wrap design permits wrapping of both heavy and lightweight coils with a tight, safe wrap. The larger capacity of the machine permits larger rolls of paper, minimizing stops for paper loading. The UW-16 is the first machine designed especially for the extreme size of coils now required by industry.

The UW-16 joins a complete line of Ludlow spiral-wrapping equipment. Spiralwrapping machines now range in gap width from 4" to 16" . . . Accessories include a variety of special devices and papers as indicated below:



1. DEVICES for folding, edging and tension control.

2. CREPED WRAP includes regular and waxed kraft, asphalt and non-staining laminated, reinforced, VPI and non-asphaltic neutral (for anti-rust), and polyethylene coated or laminated.

3. PRINTED with your name or trademark in one or more colors if desired.

4. RODS and straight lengths as well as coils can be wrapped better at less cost on Ludlow spiralwrap machines.

When writing for information, be sure to describe the nature and dimensions of the product you wish to wrap. Trained Ludlow technicians are always available for an on-the-job analysis of your packaging problems.

CIFICATIONS: UW-16 BOTTOM WRAP MACHINE
VER: 220V/440V, 3 Phase, 60 Cycle Standard wiring
ETY FEATURE: 110V controls • **SHUTTLE MOTOR:** 1½ h.p.
D ROLL MOTOR: ½ h.p. • **GUIDE ROLL MOTOR:** ½ h.p.
reduction gear • **HEIGHT:** 156" (based on 107" O.D. coil)
E: 66" wide x 63" long • **WEIGHT:** 5000 lbs. • **PAPER ROLL**
: 14" diameter x 5" wide; 1⅞" core • **MAX. WRAPPING**
PER ROLL: 107" O.D. coil (80" I.D. x 15" Traverse)

See this colored movie at our Show . . .

Ludlow

Ask for a private showing at your own plant. Write: LUDLOW PAPERS, INC., Needham Heights 94, Massachusetts

BLANE 2100 COMPOUND

WHY WAS IT CHOSEN BY MAJOR AIRCRAFT MANUFACTURERS FOR JET PLANE WIRING?

Because Tests show Blane #2100 provides the most insulation resistance over the full operating temperature range of any insulating material.

BLANE #2100 is specifically designed for use as a primary insulation in applications such as MIL-W-5086, MIL-W-16878A, and NAS-702 requiring temperature ranges from 105°C to −55°C. This quality material combines excellent high temperature properties with superior low temperature characteristics recommended for thin wall insulations.

These important features, plus outstanding electrical properties, make this smooth processing compound applicable for many government specifications including jet aircraft, missiles, rockets and machine wiring.

We suggest you examine Blane #2100 Compound yourself. Write for technical data, samples and information on applications.

THE BLANE CORPORATION

BLANE

CANTON, MASS.

KEYSTONE XL *flowability* is the secret of volume production at Thompson-Bremer & Co.

DIVISION OF AMERICAN MACHINE & FOUNDRY CO.

Users of Sems fasteners recognize this familiar symbol as the Everlock trademark of Thompson-Bremer & Co. division of American Machine & Foundry Co., Chicago, Illinois. Using Keystone XL Wire, head cracking is eliminated and die life increased 30%. They manufacture many fasteners in two blows including this 5 diameter Sems, or this Phillips hex screw with a 4½ diameter head and extruded pilot point. Keystone and Thompson-Bremer worked together to develop just the right wire to produce a better quality product at a competitive cost. Confidential counseling and metallurgical assistance is yours for the asking, too! Call us.

Keystone Steel & Wire Company, Peoria 7, Illinois

KEYSTONE
WIRE FOR INDUSTRY

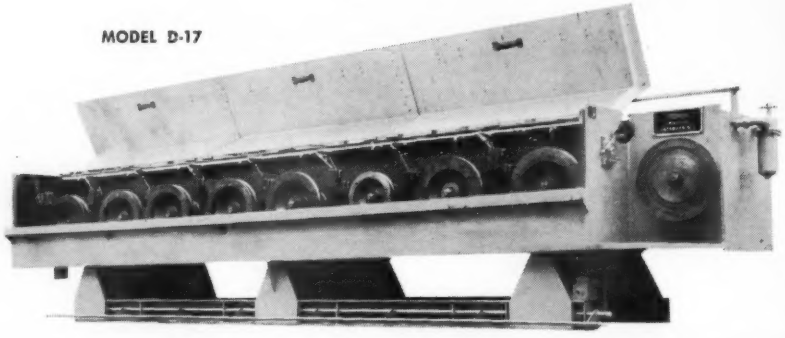
now, reduce 5/16" copper rod to #34 B&S gauge wire in only 2 steps

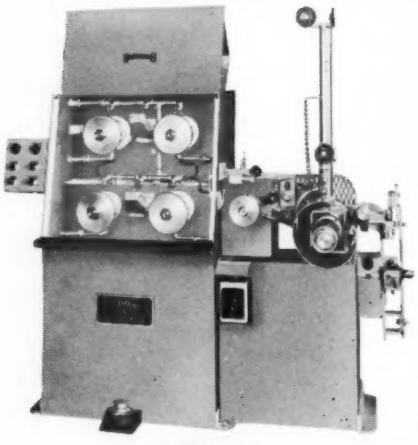
COOK

EQUIPMENT ELIMINATES 1 MACHINE LOWERS PRODUCTION COSTS

Now, with only 2 machines, in only 2 production steps, you can reduce 5/16" copper rod to #34 B&S gauge ANNEALED* wire. By eliminating one step, you save the cost of one machine and the cost of producing unnecessary intermediate wire sizes. And, with these Cook machines, you'll produce the highest quality wire at speeds up to 5,000 feet a minute.

MODEL D-17





MODEL F-31

Maximum Size of Entering Rod	5/16" Copper 3/8" Aluminum
Finished Wire Size	No. 8 to No. 19 B&S Gauge
Maximum Operating Speed	5000 F.P.M.
Maximum Number of Dies	17
Number of Drawing Blocks	8
Maximum Size of Die Case	1½" dia x 1" thick
Spool Capacity	1000 lbs.
Spool Traverse	11"
Spool Diameter	30"
Motor Size	150 HP

Maximum Wire Entering Size	#14 B&S Gauge
Finished Wire Size	#26 to #34 B&S Gauge
Operating Speed	5000 ft./minute
Maximum Number of Dies	16
Number of Drawing Shafts	4
Size of Die Case	1" x ½" thick
Motor Size	15 HP
Spool Capacity	40 to 90 lbs.
Spool Flange Diameter	8" to 12"
Spool Traverse	6" to 8"

*** MODEL F-31 (above) available as a combination drawing and annealing machine**

COOK MANUFACTURING CO.

50 EAST 25th STREET, PATERSON, N. J. • ARmory 4-6380

CANADIAN AGENT
E. V. LARSON CO., LTD., TORONTO, CANADA

EUROPEAN AGENTS
KNOERZER & CO., STUTTGART, GERMANY
CAPAMADJIAN LE MONNIER CIE LTD., PARIS, FRANCE

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COULDN'T
BE DONE
BUT
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WIRE and WIRE PRODUCTS

reaches many prospects

YOUR SALESMEN DON'T KNOW!

No matter how big you are, the odds are you don't know all your actual prospective customers.

If your company is small, it is even more important to be "calling" on your prospects and customers regularly through advertising.

Your advertising in Wire and Wire Products will be seen by many people in the plants you wish to "sell", whom your salesmen never would see, yet who specify, actually buy or who influence decisions on products to be purchased. Your advertising is bound to be of immeasurable value to you, too, in paving the way for a good reception for your salesmen when they do call. And the field's buying power is tremendous!

WIRE AND WIRE PRODUCTS circulation is all paid. We have no agents, offer no premiums or make special inducements to get circulation, except the value of the editorial contents in itself—yet our renewals have averaged 97% or better for many years. That's why it is a good and forceful advertising medium for all concerns who have products to sell to this vigorous and progressive industry.

———— • ————

Subscribers by Types of Mills in the Industry

1. Rod, Bar and Wire (producers of rod, bar and wire in all metals and shapes) 38%
2. Forming and Fabricating Plants (mfrs., largely from purchased wire, of springs, wire cloth, bolts, nuts, screws, rivets, wire forms, fences and fencing, wire specialties, wire rope and electric wire and cable) 59%
3. Miscellaneous—Libraries, Research Organizations, Jobbers, Distribution, etc. 3%

Subscribers by Types of Positions Held

1. Executives: Presidents, Vice Presidents, Secretary-Treasurers, Purchasing Agents, Sales Managers 22%
2. Operating: Vice Presidents, General Managers, Works Managers, Superintendents and Assistant Superintendents. 58%
3. Research and Maintenance: Plant Engineers, Metallurgists, Laboratory Technicians, Foremen and Inspectors 19%
4. Libraries 1%

———— • ————

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• ADVERTISE IN WIRE AND WIRE PRODUCTS.....

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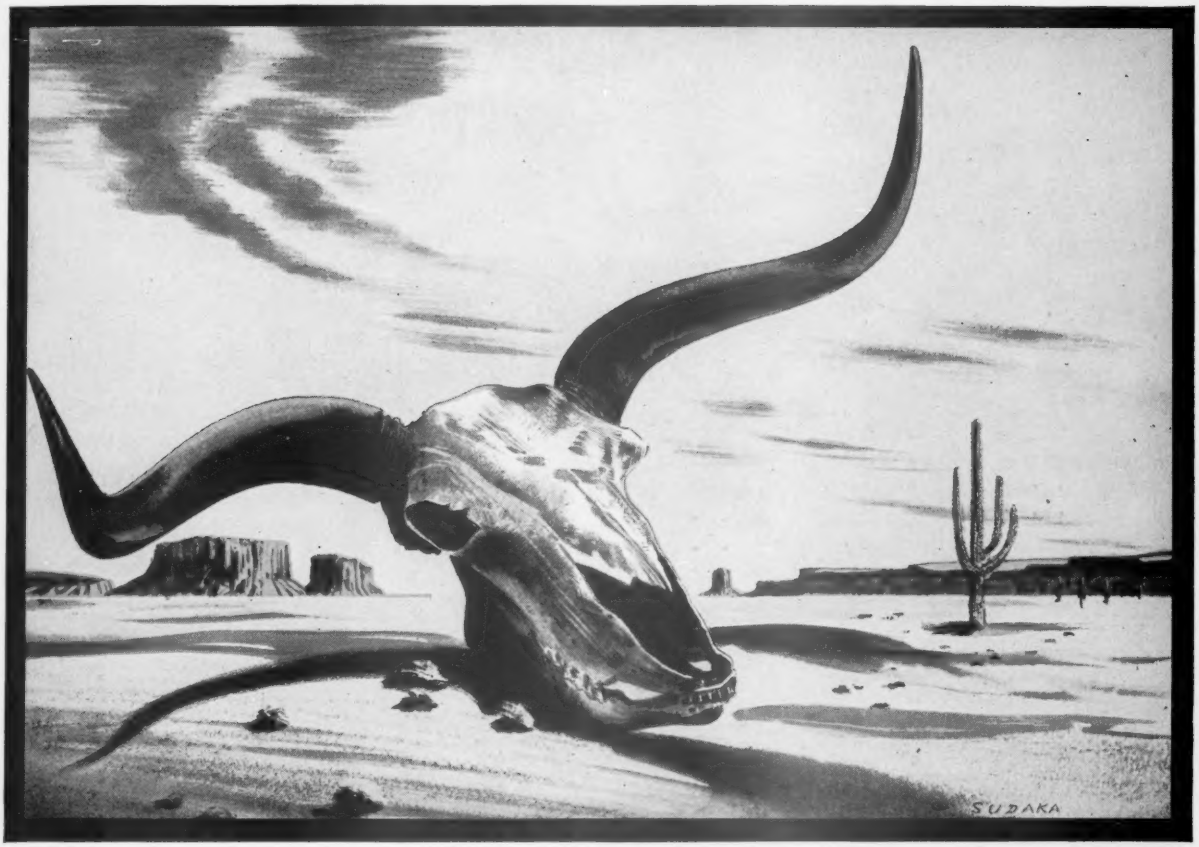
WIRE and WIRE PRODUCTS

453 MAIN STREET • STAMFORD, CONN.

Naugatuck NAUGAPOL

specially processed R-S rubber



bone dry

...always!

A BONE parching on the desert couldn't hold much less moisture than a rubber product made of NAUGAPOL®. All 6 "hot" types (1016, 1018, 1019, 1021, 1022 and 1023) and both "cold" types (1503 and 1504) of Naugapol are *specially processed for low moisture absorption* by eliminating salt as a coagulant following polymerization. Extra straining and milling further help to produce salt-free elastomers characterized by:

- **LOW MOISTURE ABSORPTION**
- **HIGH DIELECTRIC PROPERTIES**
- **CLEANLINESS & UNIFORMITY**
- **EASE OF PROCESSING**

That's why NAUGAPOL butadiene-styrene polymers are so strongly preferred by manufacturers of rubber-insulated wire and cable, mechanical rubber goods and other rubber products requiring high electrical insulating qualities and excellent mechanical characteristics over a wide temperature range. Many grades of NAUGAPOL are non-discoloring, Polygard®-stabilized polymers suitable for the finest transparent, white or color-pigmented products.

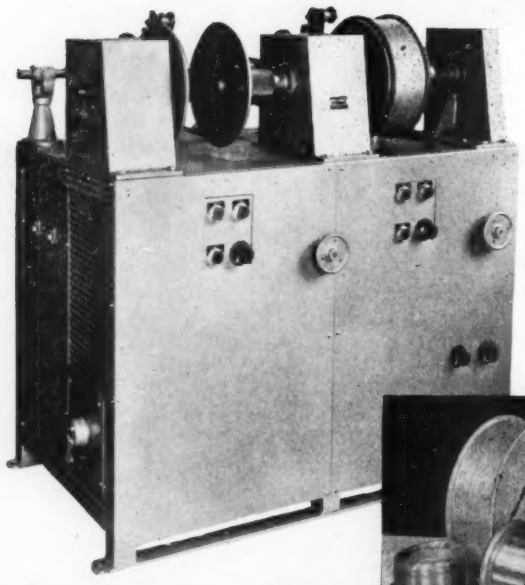
Naugatuck Chemical

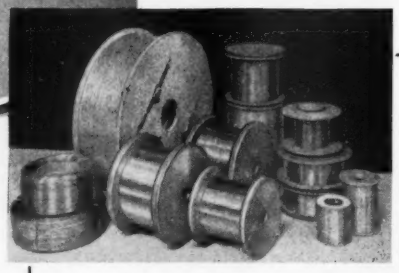
Division of United States Rubber Company 1029 N Elm Street Naugatuck, Connecticut

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N.Y.

LATEST

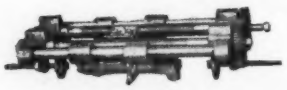
AUTOMATED MULTI-SPINDLE ROBERT J. EMORY SPOOLER





MODEL 400 B Two to Ten Heads. Integral Payoff. Non-removable arbors. 3000 RPM Speed. Automatic Stops. No vibration.

ADVANCED DESIGN • HIGHEST PRODUCTION • ACCURATE WINDING • WIDEST RANGE • FULLY ADJUSTABLE • ONE MAN OPERATION • PRODUCTION PROVEN • MODERATE PRICE



EMORY NO. 700 TRAVERSE

Minimum number of wear parts. Two precision cut buttress thread screws are engaged alternately by bronze half nuts, giving absolutely positive, pin-point reversal. The "Trigger Action" reversing mechanism can be adjusted from 1½" minimum travel to maximum without stopping the spooler.

EMORY NO. 901 TINNING SPOOLER

This 24-spindle spooler handles wire from .003" to .080" in diam. Each spindle is operated as an independent member. Can be built to handle customer's spool size.

DETAILED FEATURES

1. Electrically controlled, run, stop, jog, speed
2. Individual drives for each spindle by motor or magnetic clutch
3. Variable speed spindles and traverse 18 to 1 ratio
4. Wire range One to 200 mils diameter
5. Fast spool and reel changes in seconds
6. Winds spools or tied cores
7. One to 200 lb. capacity
8. Automatic stops on each spindle for full spool or wire fracture
9. Controlled and calibrated tension
10. Uniform thread winding
11. Large capacity reels positioned on inclined bearings close to floor to eliminate lifting.
12. Power drawn synchronized payoff
13. Constant linear speed of annealing and tinning operations
14. Electrically controlled drags and brakes synchronized with winding spindle.
15. Available for braider — bobbin winding of multiple end strands at highest winding speeds, simplest operation
16. Special construction for winding magnet wire on disposable plastic or masonite spools.

ROBERT J. EMORY COMPANY
31 East Runyon Street Newark 5, N. J.

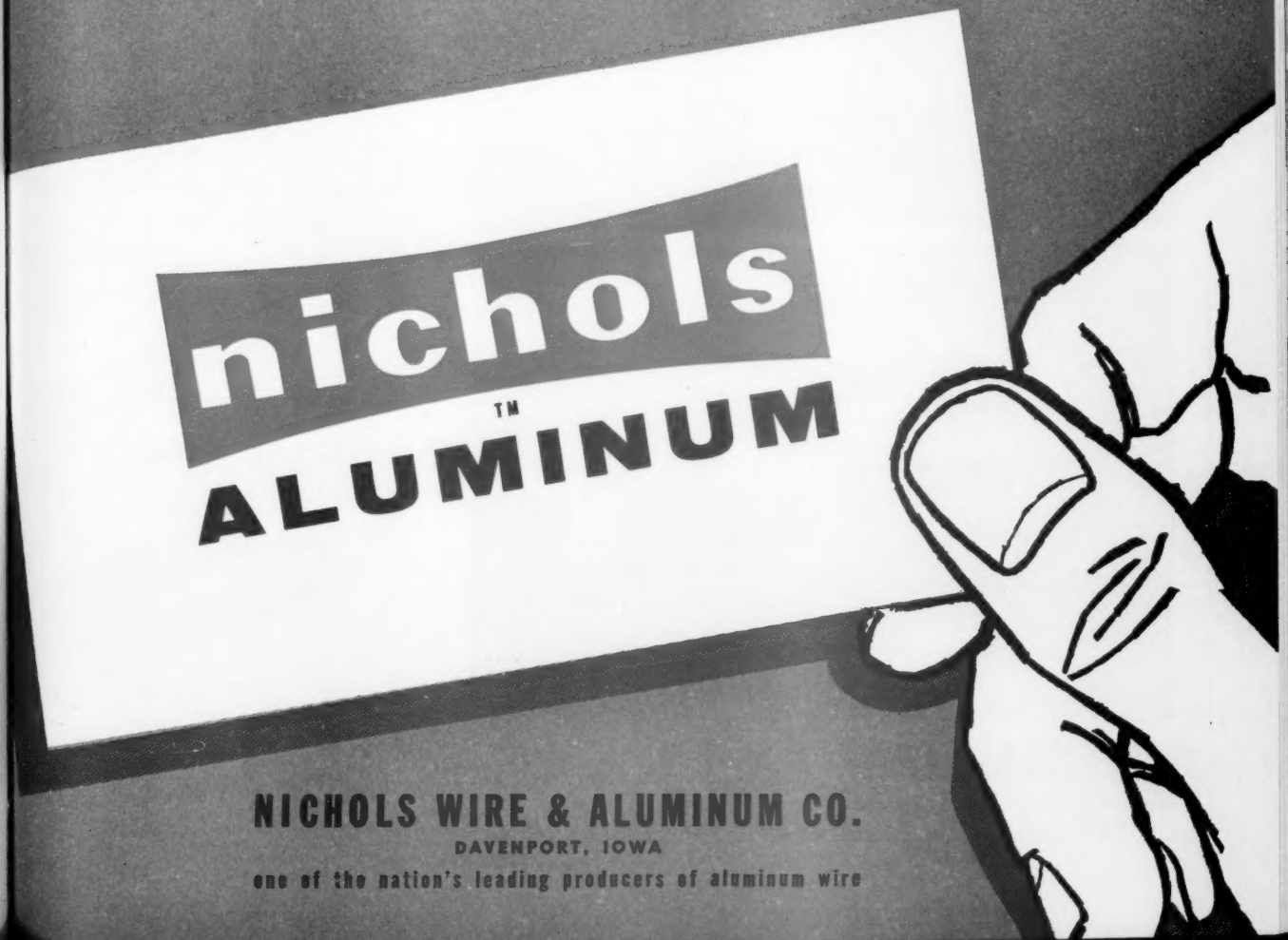
60 YEARS OF WIRE MACHINERY EXPERIENCE

aluminum wire

MADE TO YOUR EXACT SPECIFICATIONS

The Nichols trademark on aluminum wire is your assurance of a uniform high quality product made to meet your own particular forming requirements through rigid quality control standards.

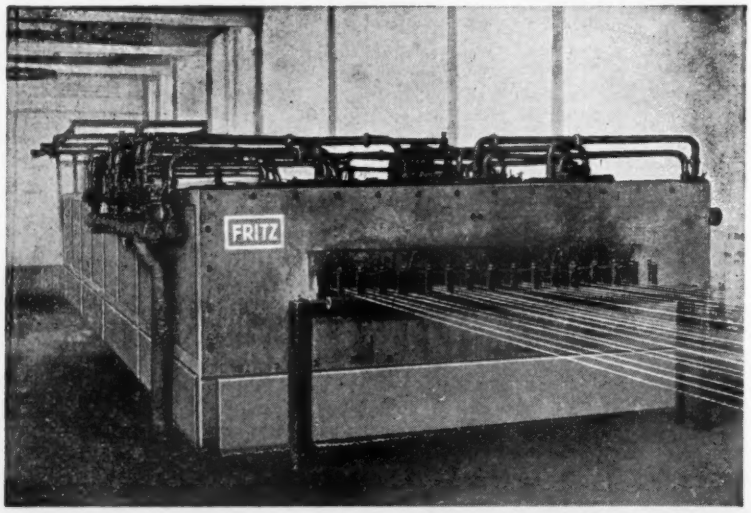
Write us today about how you can use Nichols Aluminum Wire. Excellent delivery.

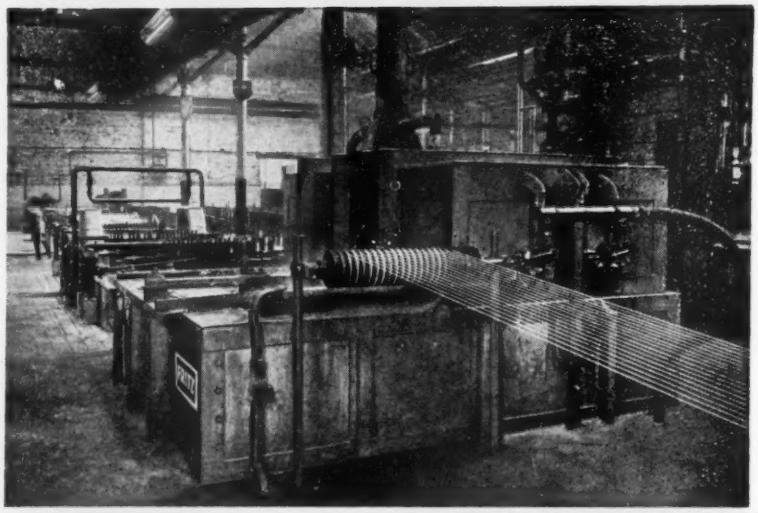


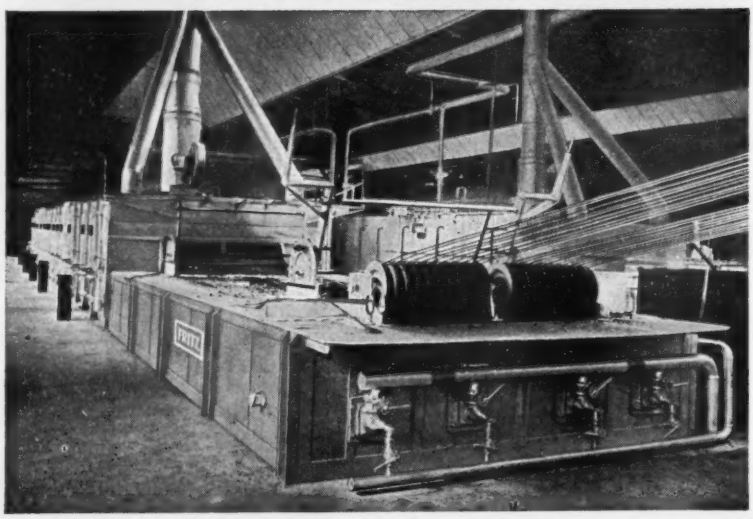
NICHOLS WIRE & ALUMINUM CO.

DAVENPORT, IOWA

one of the nation's leading producers of aluminum wire







THIS IS MODERN

Galvanizing Equipment

FROM GERMANY!

Pull-through furnace for iron wire

"System Becker"

(German & Foreign Patents)

No muffler — lowest consumption figures — reduced floor space requirements.

Cover-Heated **Galvanising Furnace** with everlasting ceramic tank.

(German or Foreign Patents)

Less dross — no zinc run-out channels — unlimited life of pot — no break-downs.

☆

And for your Steel Wire:

PATENTING FURNACES

"System Jansen"

☆

Oil or gas heating

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Representative for Canada : U. S. A.: P. Reicher Machinery & Equipment, 600 Eglinton Ave., East, Toronto 12, Ont., Canada

NATIONAL

(COLD ROLLED)

WIRE

...Ferrous or Non-ferrous,
in Coils or Straight Lengths

- Round Edge Flat Wire
- Square Edge Flat Wire
- Keystone Shaped Wire
- Oval Wire
- Half Oval Wire
- Half Round Wire
- Special Shaped Wire
- Spring Washers
- Retaining Rings

Complete Metallurgical Service

The NATIONAL LOCK WASHER COMPANY

Precision Shaped Wire Division

NEWARK 5, NEW JERSEY MILWAUKEE 2, WISCONSIN

3 *Reasons*

why

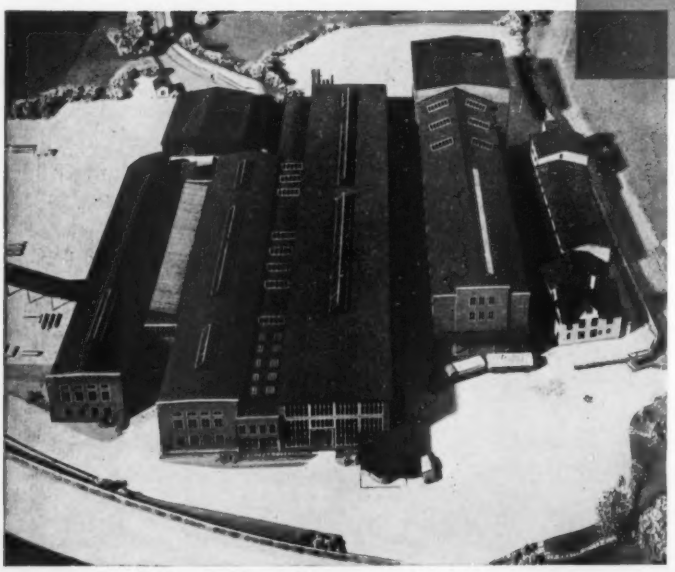
HERBORN Wire Drawing Machines

have found acceptance throughout the entire world

(1) modern assembly plants and equipment guarantee prime quality and workmanship.

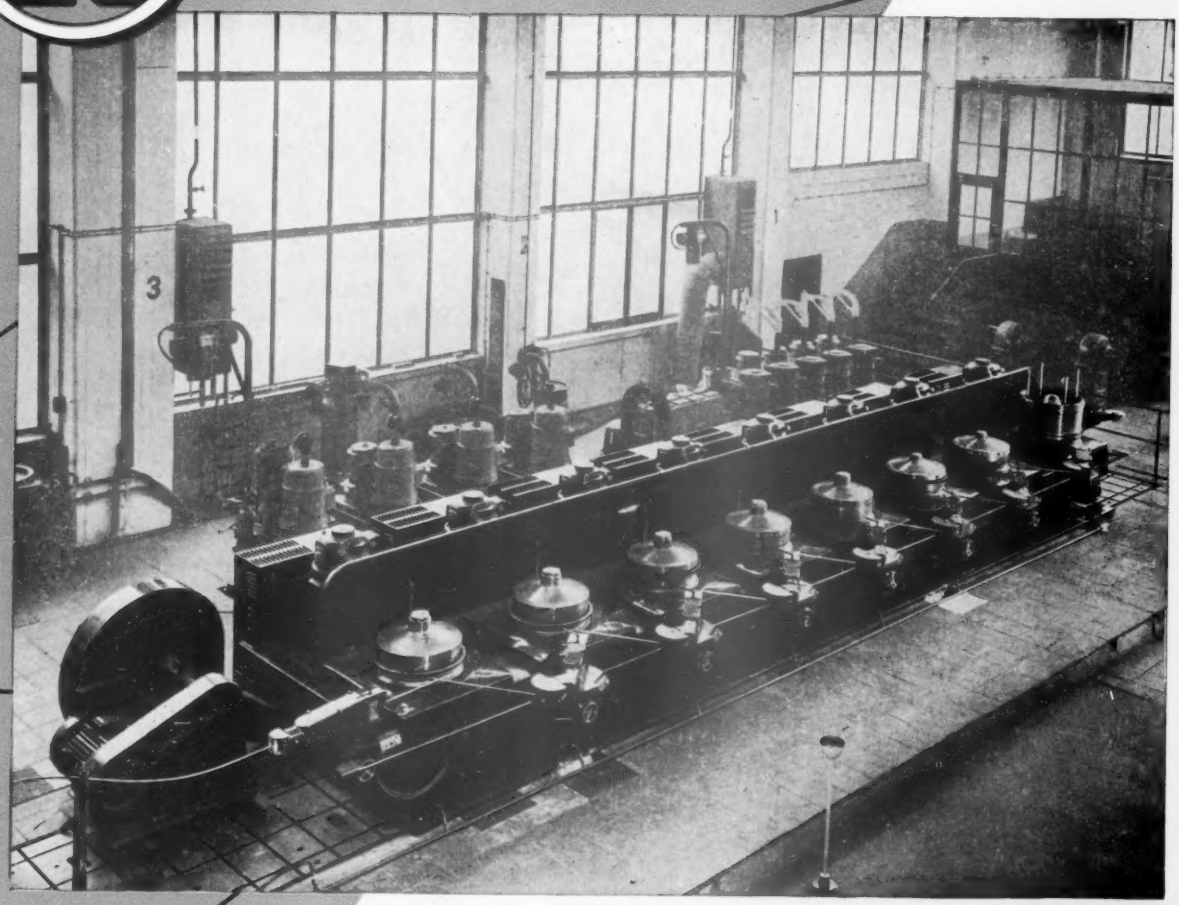
(2) operating experience for our machines is provided by our own wire mills.

(3) our comprehensive fabrication program can fill all requirements of the wire drawing industry.



Our Plant

HERBORN



HERBORN straight-through wire drawing machine model G Ia with 3 to 8 drafts,

alternating current drive, with air- and water cooling system, for the drawing of medium and high carbon spring wire with starting size from 3/8" diameter, as well as non-ferrous wires of suitable diameters.

Please send us your inquiries, we shall be glad to submit suggestions and proposals

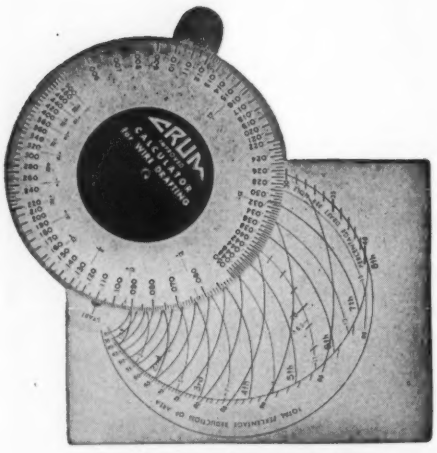
MASCHINENFABRIK HERBORN
BERKENHOFF & DREBES A. G., HERBORN/GERMANY

HERBORN MACHINERY CORPORATION
61 Hudson Street
Hackensack, N. J.

SAVE SET-UP TIME WITH THE...

CRUM CALCULATOR
FOR WIRE DRAFTING

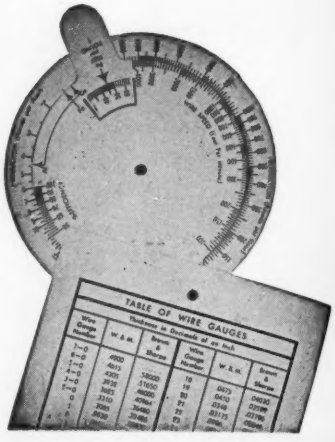
Useful and Accurate!



Front view of Crum Calculator

THIS NEW DOUBLE-PURPOSE CALCULATOR WILL:

1. **Provide quicker and more accurate information on die sizes and reduction areas;**
2. **Calculate wire production rates for various speeds and efficiencies.**



Reverse view of Crum Calculator

SOME OTHER FEATURES OF THE CALCULATOR

- Has new scale for more accurate determination of small percentages.
- Gives readings in B & S gauges.
- Intermediate lines provide reductions for 16 holes in one setting.
- New rectangular shaped back for better protection of calculator.
- More legible % draft-per-hole scale.
- Vinyl plastic construction, resistant to wear, warping, dirt, perspiration, wire drawing soaps—can be cleaned.
- Still fits your vest pocket.
- Handy tables of W & M and B & S gauges.
- Feet per pound calculating scale for steel, copper and aluminum wires.
- Durable, accurate, easy to use.

The improved Crum Calculator is worth its weight in gold in time saving—no laborious mathematical calculations necessary when you use it. Instruction sheet with examples accompany each Calculator. You should have one or more in your wire drawing department.

THE PRICE: $5.00 EACH

Send your orders to:

WIRE AND WIRE PRODUCTS

453 MAIN STREET **STAMFORD, CONN.**

(Exclusive distributors)

USE FILTERED MINERAL OIL INSTEAD OF SOLUBLE OIL

Wire drawing firms are saving as much as $12,000 a year by replacing soluble oil in the lubrication of dies with continuously filtered mineral oil. They thus eliminate build up of fats in the equipment, clogging of jets, and interrupted production necessitated for cleaning purposes.

By shifting to mineral oil and filtering it they now enjoy these advantages:

1. The oil remains in the same condition as new. It does not have to be changed—not just for months, but for years.

2. Die life is increased 50% or more.

3. Higher drawing speeds can be employed.

4. It is possible, in many cases to substitute Carbide Dies in place of diamond dies.

5. Clogged oil passages causing burned dies are eliminated.

The procedure is simple. A mineral oil of low viscosity, containing E. P. additive and having high heat conductivity is used. This oil is then passed through a Hercules Pressure Leaf Filter to remove suspended solids. Since diamond and metal dust is removed from the oil continuously the oil can be used indefinitely.

We have several score of our Pressure Leaf Filters in use by wire drawing concerns for the filtration of mineral oils. In most installations these machines have paid for themselves in a few months through lowered oil and die costs and increased production (For example one concern is now drawing 21,000 pounds of wire before changing a die as compared with 6,000 pounds when it was using soluble oil).

Why continue to suffer short die life, reduced drawing speeds, lowered production and high oil costs when you can eliminate these disadvantages through the use of Hercules Filters and mineral oil?

For full details of this method of using mineral oil and a Hercules Pressure Leaf Filter in your wire drawing operation write for Paper delivered before The Wire Association in New York City, which gives complete data on the economy and effects of using filtered mineral oil for the lubrication of wire drawing machines.

Filtration of Lubricants for Aluminum Wire Drawing

by H. T. Jones, Jr., Vice President
Hercules Filter Corporation
Hawthorne, New Jersey

HERCULES FILTER CORPORATION 191 Ethyl Avenue Hawthorne, New Jersey

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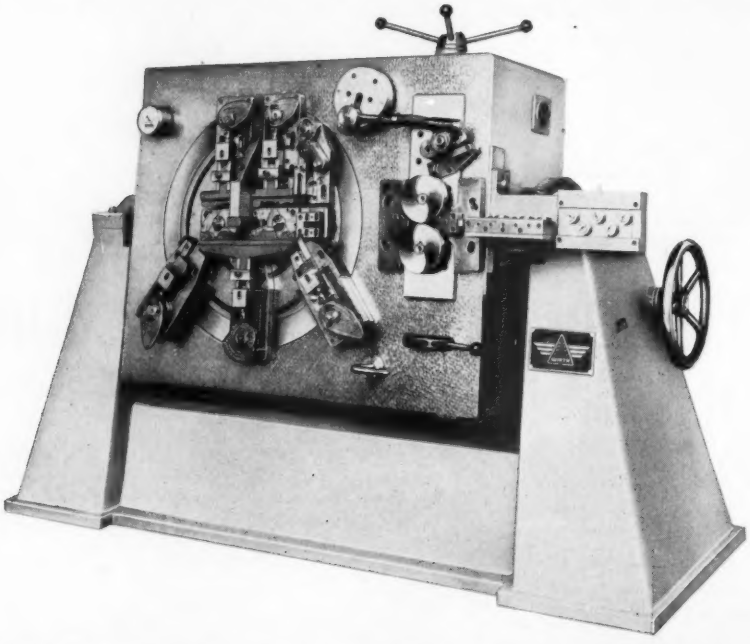
presents

the world's most advanced

UNIVERSAL MULTI-SLIDE FORMING MACHINES



Model XK 400
for wire up to
¼" diameter.

A complete line of West German-made, Universal Multi-Slide Forming Machines for wire and strip. All models can combine up to 40 operations, with ability to form the most complicated parts, including Pointing, Welding and Forming of Torsion Springs up to 20 coils.

ALSO DESIGNERS AND BUILDERS OF AUTOMATIC MACHINERY FOR YOUR SPECIAL REQUIREMENTS

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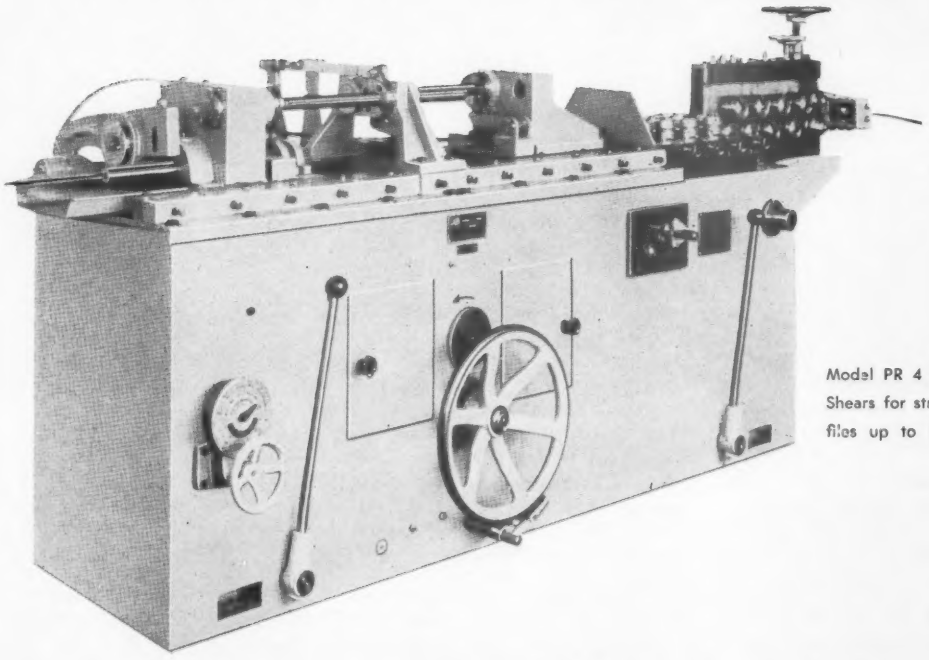
STRAIGHTENING AND CUTTING MACHINES



Model PR 4 with Flying Shears for strip and profiles up to 1¾" width

A complete line of Automatic Straightening and Cutting Machines manufactured by the Koch Co. in Western Germany for Wire, Bars, Rods, Profiles, etc.

ALSO DESIGNERS AND BUILDERS OF AUTOMATIC MACHINERY FOR YOUR SPECIAL REQUIREMENTS

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LOW COST—HIGH QUALITY SPARKER

GUARANTEED FOR 5 YEARS

DC & AC UNIVERSAL TYPE

GUARANTEED TO OUTPERFORM OTHER UNITS IN ANY PRICE RANGE

●

Used by leading manufacturers (names on request) of insulated wire

FEATURES:

Any speed, 400 fpm per 1" of electrode (2400 fpm with 6" long electrode)
DC or AC output
Accurate at any speed
Rugged construction with long life selenium rectifiers
Maximum test current, 4 ma.
Electronic fault relay for sensitivity and reliability
Reliable operation down to 5% of maximum output voltage
For use on extruder or respooler
3 conductor grounding type cord and plug
Provision for lock-in type white light with reset and buzzer fault indication in addition to magnetic counter
Output KV meter with linear scale directly at output for accurate indication, with provision for easy field recalibration.
Fast magnetic counter with quick reset lever
Simplified controls for use by inexperienced personnel

The electronic fault relay provides fast, accurate and reliable indication of faults, even at very low output voltages, (a typical 14 KV DC Sparker will work at 700 volts). Output voltage is continuously adjustable from zero to maximum output. Input is 115V lighting circuit. May also be used as a Potential Tester for checking cable.

Besides Model S14CV-AC/DC, shown above, other Sparkers with lower or higher output voltages are available: S7CV-AC/DC; S20CV-AC/DC; and S30CV-DC. Higher output voltage units on order.

SPECIFICATIONS:

CABINET SIZE — 8" X 14" X 8" deep.
WEIGHT — 23 pounds, net.
PRICE — $375.00 (1 piece) (less in quantity) Model S14CV-AC/DC.

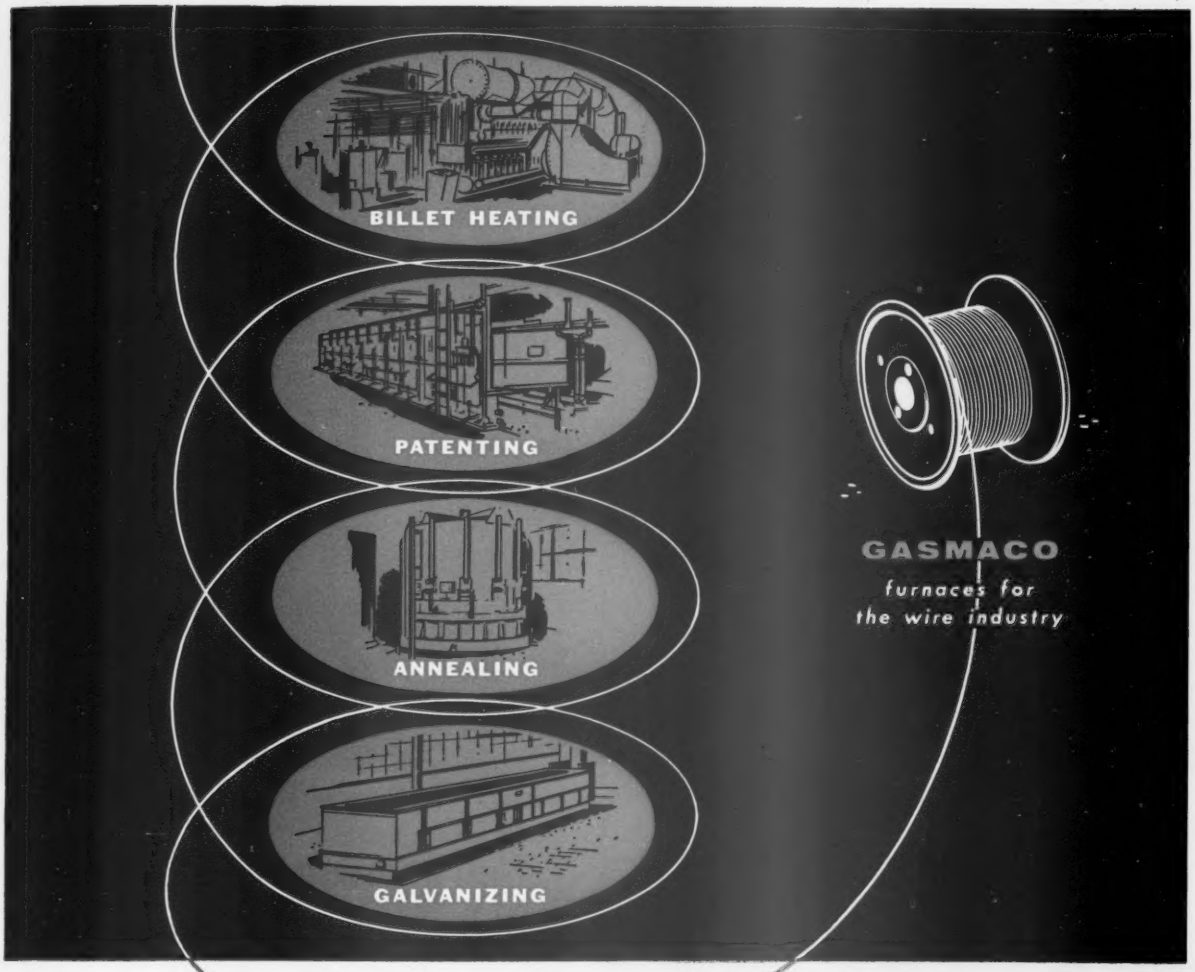
PESCHEL ELECTRONICS, Inc. has during the past few years advocated and has actually built into Sparkers modern features to improve performance, enhance reliability, and reduce cost. Peschels efforts to sell the wire industry on: DC Sparking; extremely short electrodes; very low, safe testing current; and small compact units, has paid off. Continued use of DC Sparkers by prominent wire manufacturers will eventually standardize this method.

FOR BEST VALUE SPECIFY PESCHEL SPARKERS, SOLD WITH A MONEY-BACK GUARANTEE AND A FIVE-YEAR WARRANTY AGREEMENT. A TRIAL WILL PROVE OUR POINT. INQUIRIES INVITED.

Other Test Sets available: DC Overpotential Testers; Sensitive Hipot Testers; Dielectric Test Sets for full reel testing; Corona Test Sets; Cable Fault Locating Sets.

PESCHEL ELECTRONICS, INC.

R. F. D. #1, PATTERSON, NEW YORK — TRinity 8-3251



WIRE MILL FURNACES

In the world of wire, the following GASMACO Furnaces are speeding production and improving quality . . .

BILLET HEATING—GASMACO reverse flueing . . . recuperative . . . designed to eliminate mill delay problems . . . single zone and double zone . . . up to 100 tons/hr.

PATENTING—GASMACO patented* silicon carbide radiant tubes permit high temperature operation with atmosphere . . . also direct-fired . . . either type supplied complete with lead quench or acid bath . . . up to 8000 lbs./hr.

ANNEALING—GASMACO single stack, direct-fired design . . . for rod or wire . . . alloy inner cover . . . tangentially fired . . . special pedestals.

GALVANIZING—GASMACO special design . . . fired along sides of tank . . . no flame impingement . . . reduces drossing.

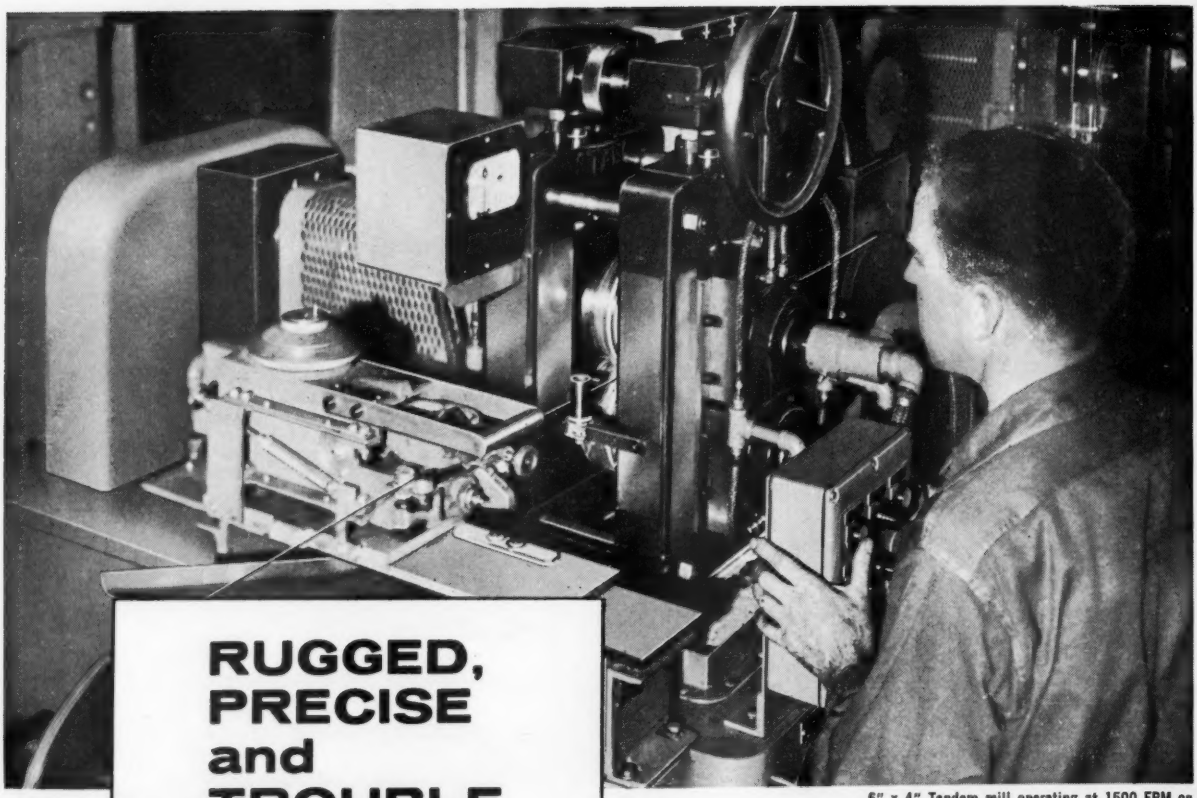
THE GAS MACHINERY COMPANY, INDUSTRIAL FURNACE DIVISION
16128 Waterloo Road, Cleveland 10, Ohio
In Canada: The Gas Machinery Co. (Canada) Ltd., Hamilton, Ont.

*Send for Bulletin A-106 GASMACO SILICON CARBIDE RADIANT TUBE FURNACE IMPROVES WIRE PATENTING OPERATION.

✓ *Check first with GASMACO for latest industrial furnace designs.*

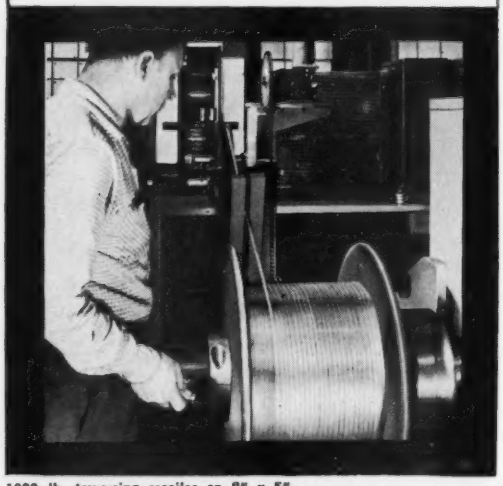
THE **gas machinery** COMPANY

GAS PLANT EQUIPMENT
AND INDUSTRIAL FURNACES



6" x 4" Tandem mill operating at 1500 FPM on high carbon steel at Page Steel Division—ACCO.

RUGGED, PRECISE and TROUBLE FREE



1000 lb. traversing recoiler on 8" x 5" tandem line at Kagan Dixon Wire Corp.

STANAT WIRE FLATTENING MILLS

Stanat mills are designed to consistently give you extremely close tolerances combined with high speed production.

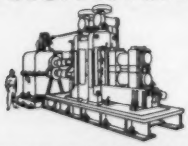
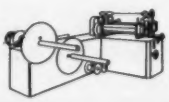
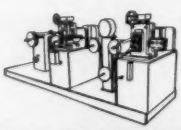
Simplicity of design insures minimum maintenance and frequently permits one man operation.

All Stanat mills include such quality features as completely enclosed permanently lubricated worm gear screwdowns; fully adjustable traversing recoiler; herringbone drive; anti-friction bearings at all critical wear points.

Stanat single and tandem wire flattening mills are available in sizes up to 10" roll diameter either as completely self-contained package units or as individual components for erection at your plant.

STANAT
MANUFACTURING CO., INC.

500 SHAMES DRIVE WESTBURY, L. I., N.Y.
IN EUROPE: STANAT-MANN, ESSEX, ENGLAND

MFR'S OF ROLLING MILLS, GANG SLITTERS, WIRE FLATTENING MILLS, ROLLER LEVELERS AND BULL BLOCKS

Plainly . . .
marked superiority

whether in stock or
on your production line

SCOVILL

BRASS-COPPER-ALUMINUM

UNIFORMITY beyond the usual . . . CLOSEST control of temper and metal structure . . . EXACT dimensions consistently maintained . . . EXTRA-LONG-RUN coils of Strip or Sheet when required . . . MODERN PACKAGING for efficient handling and your protection . . . including "PAYOFFPAK" for wire.

There's a PROFITABLE difference in the way Scovill delivers these PLUS VALUES . . . order after order, lot after lot . . . made better to . . .

bring out the BEST in your fabricated products

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to recognize
superior
quality
brass
copper
aluminum
bearing this
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TO THE STANDARDS
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SCOVILL MANUFACTURING COMPANY
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Discover a new difference —
- in die life
- in brightness

FLEXAL S

A New Metal Processing Lubricant by SWIFT & COMPANY

Flexal "S" is a distinct and exclusive new lubricant that is available only through Swift & Company. It is an extremely high titer, uniform fine powder that is designed to *stay put* on the wire through multiple draws—while lubrication is required. Yet, it is easily dissolved, by hot water washing, from wires which demand a lubricant-free surface.

Flexal "S" is designed for use in either **dry drawing** or **hot dip coating** and has shown excellent results for use in combination of dry and wet draws. It will pay *you to check the specs* on FLEXAL "S". Return the coupon for details—or a trial order.

FOR DRY DRAWING or HOT DIP COATING

- Extremely high titer
- Uniform fine powder
- Water soluble stearate base
- Very low in moisture
- Contains rust inhibitor and bonding aid

To Serve Your Industry Better Swift 104TH YEAR

JUST CLIP TO YOUR LETTERHEAD AND MAIL

S-43R

SWIFT & COMPANY, INDUSTRIAL SOAP DEPT.
4115 Packers Ave., Chicago 9, Illinois.

☐ How can we place a trial order for Flexal "S" for evaluation in our operations?

☐ Please send a FREE 10 lb. sample of Flexal "S" for our evaluation.

(Please describe intended usage briefly).....

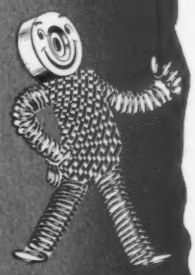
.....

Company.....

Address.....Zone....State.....

City.....

Your Name & Position.....



and FREDDIE FLEXAL invites your further inquiry

S-43R

SHEFFIELD "ALUMINIZED" WIRE—
It's Coated With COMMERCIALLY PURE ALUMINUM

Yes — it's a brand new type of wire — the first to be coated with commercially pure aluminum. Sheffield metallurgists have developed an exclusive patented process for applying this special aluminum coating to Sheffield Manufacturer's Wire.

This coating process not only gives the wire greater corrosion resistance, but also makes possible a better bond of aluminum to steel.

Teamed up with top-quality Sheffield-made steel, this new coating of commercially pure aluminum gives you a wire of superior workability. You get dimensional and metallurgical uniformity. Dependable performance in your machines and your products. Faster production and less machine down-time. Plus the lustrous eye appeal of aluminum.

Let us tell you more about this newest Sheffield product, and what it can do for you. Get in touch with your nearest Sheffield office.

SHEFFIELD
Aluminized Wire

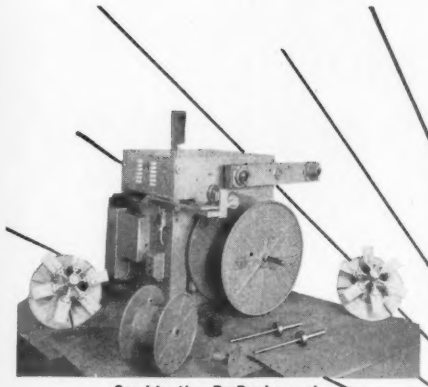
- AISI specifications 1006 and 1050
- 16-gauge through 6-gauge
- Packed in coils and in Sheffield Kone-Paks that give you on one continuous spool the equivalent of several ordinary coils of wire

WRITE FOR FREE SAMPLE

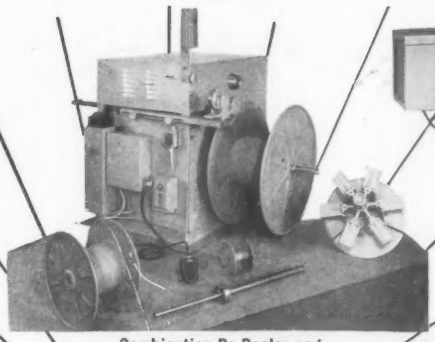
SHEFFIELD DIVISION

ARMCO STEEL CORPORATION

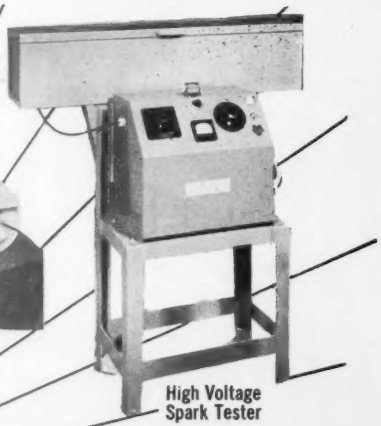
OTHER DIVISIONS AND SUBSIDIARIES: Armco Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products



Combination Re-Reeler and
Re-Spooler with Indexing Head

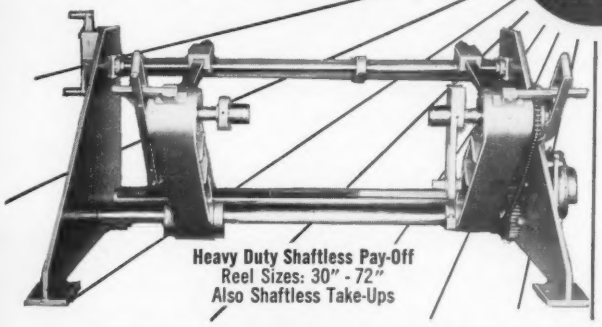


Combination Re-Reeler and
Re-Spooler with Interchangeable
Shaft Features

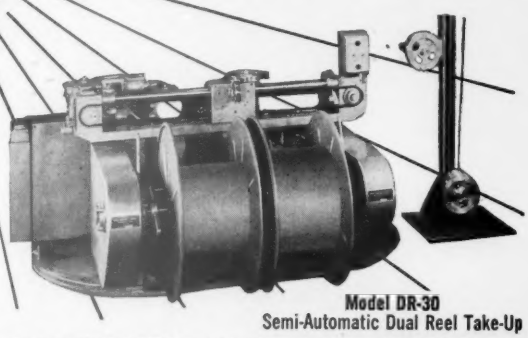


High Voltage
Spark Tester

FOR ACCURACY — DAVIS WIRE & CABLE EQUIPMENT — FOR DEPENDABILITY



Heavy Duty Shaftless Pay-Off
Reel Sizes: 30" - 72"
Also Shaftless Take-Ups



Model DR-30
Semi-Automatic Dual Reel Take-Up

THE NEWLY REDESIGNED *DAVIS WIRE & CABLE EQUIPMENT* IS BETTER THAN EVER

Modernized, streamlined and engineered for fast production of safely insulated wire and cable, the newly redesigned DAVIS ELECTRIC line of Spark Testers, Pay-Offs, Take-Ups, Counters, Spoolers, Traverses and Capstans is now offered as the finest ever conceived and produced by DAVIS ELECTRIC engineers. Before you buy, you owe it to your pocketbook as well as your business reputation to learn what this unexcelled machinery can do to better satisfy your customers (and your stockholders!). Refinements and advancement in designs qualify the 1959 DAVIS ELECTRIC line to surpass in performance previous DAVIS products in use in 80% of the industry's wire mills and some of which have been in operation for 15 years without maintenance problems!

What better tribute to quality can one ask?

Write for complete details and find out how DAVIS ELECTRIC can improve your wire and cable production and promote profit in your plant.

DAVIS WIRE & CABLE EQUIPMENT

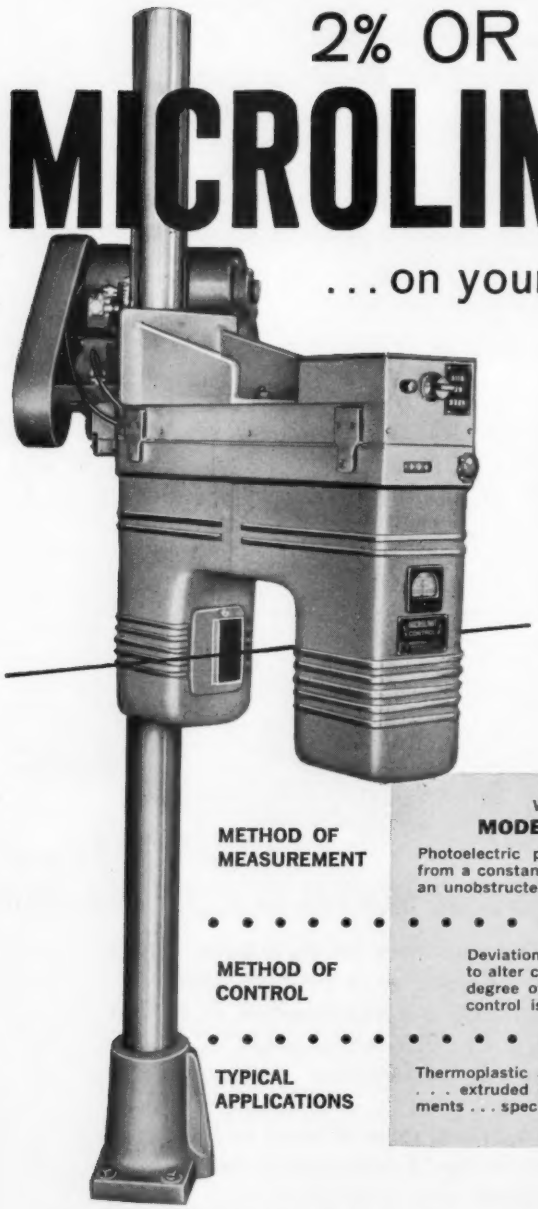
DAVIS ELECTRIC CO.

WALLINGFORD, CONNECTICUT

DUAL and SINGLE TAKE-UPS • PAY-OFFS • CAPSTANS
SPARK TESTERS • RE-SPOOLERS
RAM-TYPE TEFLON EXTRUDERS

CUT MATERIAL COSTS 2% OR MORE with MICROLIMIT GAUGES

. . . on your extrusion lines



Control diameter of insulated wire and cable filaments, rod, tubing, shapes—even while still in highly plastic state!

At any speed—even in hot or smoky atmospheres near the die!

Any diameter from .001 to 12.0 inches. Continuous . . . virtually instantaneous . . . non-contact!

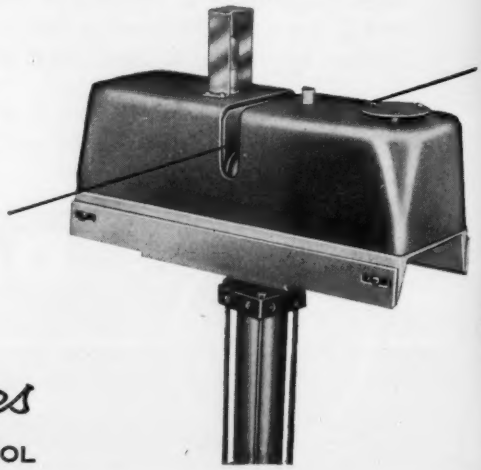
AND SAVE 2%—OR MORE—ON MATERIAL . . . BY

- **reducing deviations from your product's nominal diameter.**
- **cutting tolerances safely . . . consistently.**
- **cutting start-up wastage in half.**

REDUCE LABOR COSTS; SPEED PRODUCTION TOO!

	WIRE GAUGE **MODELS 5110/309**	CABLE GAUGE **MODELS 5120/310**
METHOD OF MEASUREMENT	Photoelectric pickup of obstructed light from a constant source—balanced against an unobstructed reference beam.	Photoelectric scanning by two light beams moving in tandem. Not affected by clouded atmospheres or deposits on lenses.
METHOD OF CONTROL	Deviation signals are fed to control console. Its output drives a conversion unit to alter capstan speed or any other production variable. Timing circuits regulate degree of correction . . . permit corrected diameter to register before further control is exercised. Systems are completely integrated to the extrusion line.	
TYPICAL APPLICATIONS	Thermoplastic and rubber insulated wire . . . extruded tubing, rods, shapes, filaments . . . special wires.	Thermoplastic insulated cable . . . C. V. process and pancured rubber cable . . . extruded tubes, shapes.

Microlimit Gauges are now sold and serviced by the Daystrom-Weston world-wide organization. For detailed bulletins . . . or other information . . . contact your local Daystrom-Weston representative, or write to Daystrom-Weston Sales Division, Newark 12, N. J. **In Canada:** *Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*



DAYSTROM WESTON

Industrial Gauges

WORLD LEADERS IN MEASUREMENT AND CONTROL

ECONOMIC PRODUCTION FLEXIBILITY for ROD and WIRE ANNEALERS

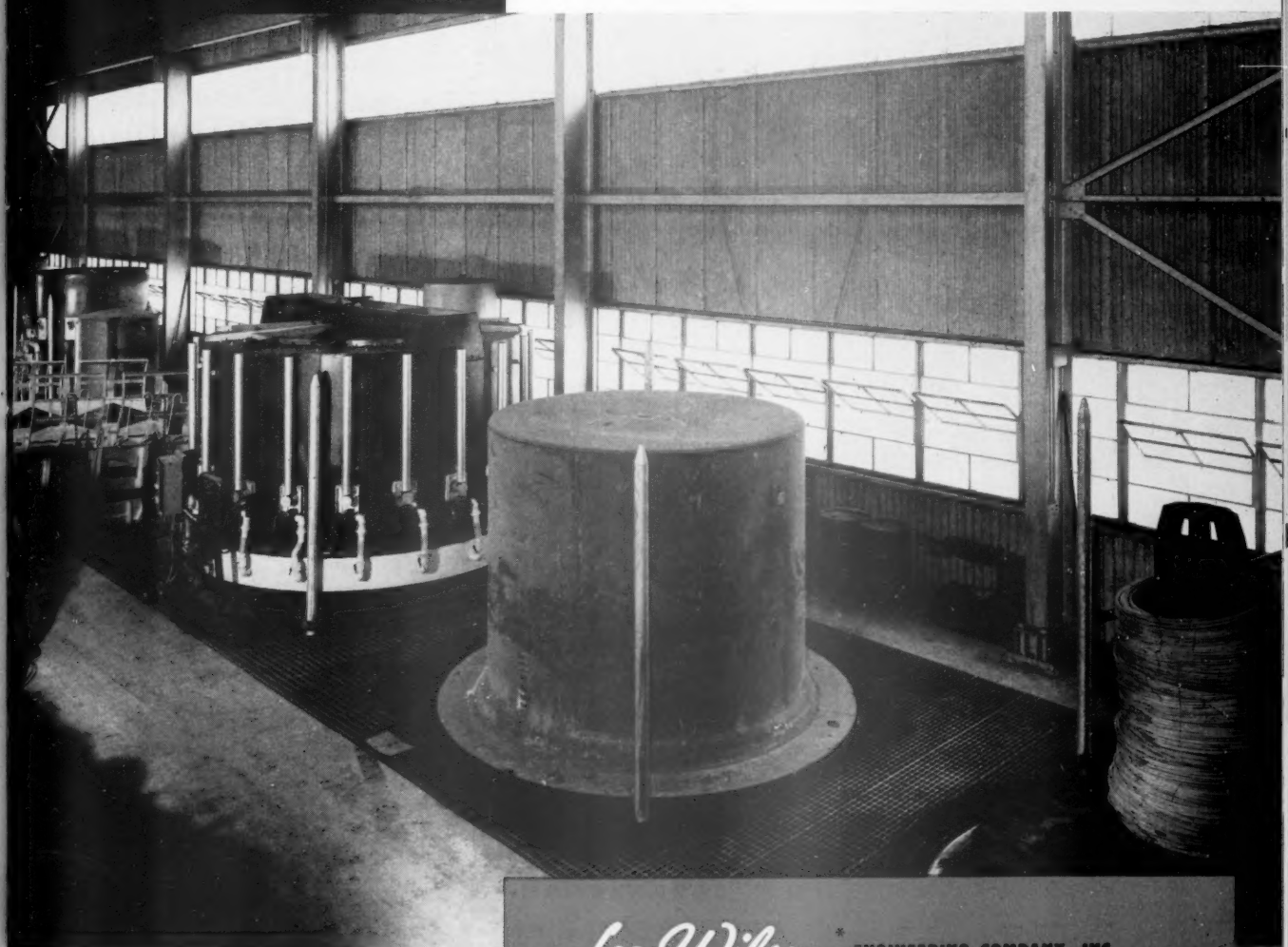
LEE WILSON engineers design system for Russell, Burdsall & Ward

Economic flexibility—that's what Russell, Burdsall & Ward have in their new annealing and spheroidizing department at their Rock Falls, Illinois, plant.

At the time RB&W decided to reconstruct their annealing operation they asked Lee Wilson engineers to design the most efficient system possible for operation under any economic condition. With flexibility as the keynote, Lee Wilson engineers reconditioned three small single-stem furnaces and added one new 108" x 90" big three- or four-stem furnace, a complete nitrogen plant and a Lee Wilson automatic loading and unloading system.

Today RB&W have an annealing-spheroidizing department that will quickly and most economically convert any amount of stock material to the specification required. They will never get "caught short" by shortages for they now have the flexibility to convert stock rod into what they need to fill even the smallest order.

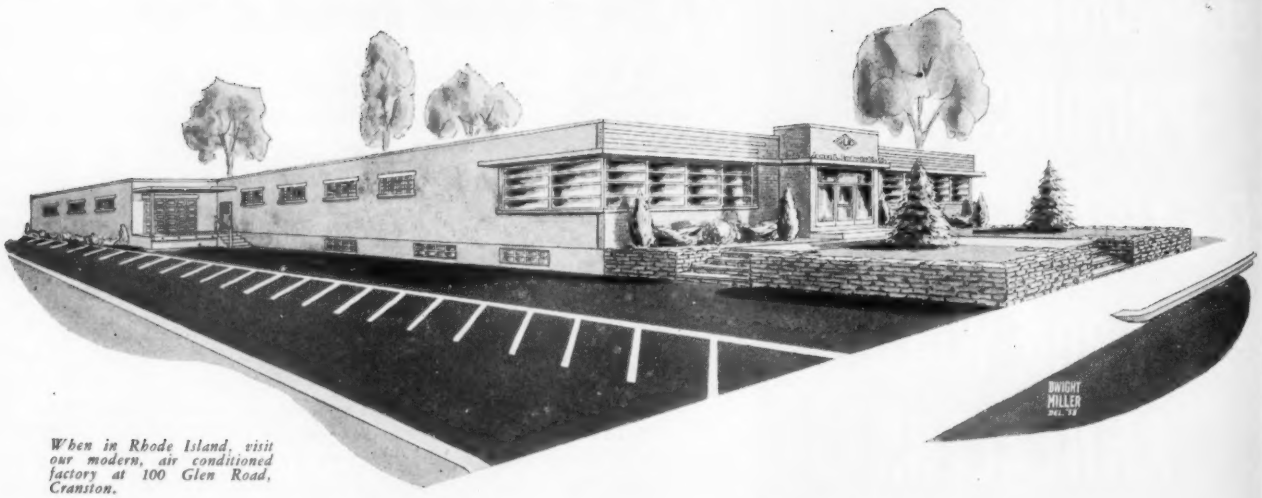
Only the Lee Wilson high convection bell type annealing furnaces can give you uniform annealing quality and the ability to adjust production to the business level.



Lee Wilson* ENGINEERING COMPANY, INC.
20005 LAKE ROAD • CLEVELAND 16, OHIO

HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES



When in Rhode Island, visit our modern, air conditioned factory at 100 Glen Road, Cranston.

QUALITY DOESN'T JUST HAPPEN . . .
IT'S ENGINEERED!

Whatever your needs in wire testing, production and handling equipment, you can be sure that every machine made by Enjaco has been designed and engineered to the limit of today's knowledge.

Every factor for efficiency, speed, durability and operator safety is built into the equipment, whether it is our competition grade "National" line, our "Imperial" quality line, or special machines designed and built to meet your particular needs.

Next time you plan to replace equipment or increase your production facilities, ask for a proposal from Enjaco. Our prices may not always be the lowest, but our quality and performance are **always** the highest.

SPARK TESTERS
A.C. and D.C.

ELECTRODE UNITS
All Types

FAULT and REEL
RECORDERS — Printing

HI-POTENTIAL TESTERS
1 to 50 Kva., 5 to 150 Kv.

REELERS and COILERS
Single and Double-Head

COLLAPSIBLE COILING REELS
4" to 84" O.D.

SPOOLERS
Single and Multi-Head

TAKE-UPS, Shaft-Type
and Shaftless

RIBBON CABLE
FABRICATING EQUIPMENT

WIRE DRAWING MACHINES
Pak or Reel Take-Up

SPIRAL STRIPING
MACHINE, "Jet Stream"

TYPE STRIPS, TYPE WHEELS,
INK

WIRE PREHEATERS
5 to 30 Kva.

MEASURING MACHINES
1, 2 and 3-Wheel Types

COUNTERS — Electrical,
Mechanical and Electronic

WIRE PAK TAKE-UPS
and PAY-OFFS

PAY-OFF REEL STANDS
Shaft and Shaftless

PATCHING PRESSES
TRAVERSE UNITS
and DANCERS

CAPSTAN UNITS —
Single, Dual-Wheel

COATING TANKS and
CURING OVENS

CUSTOM WIRE MACHINERY
Design and/or Build

CONTROL SYSTEMS
Design and/or Build

ENJACO
CORPORATION

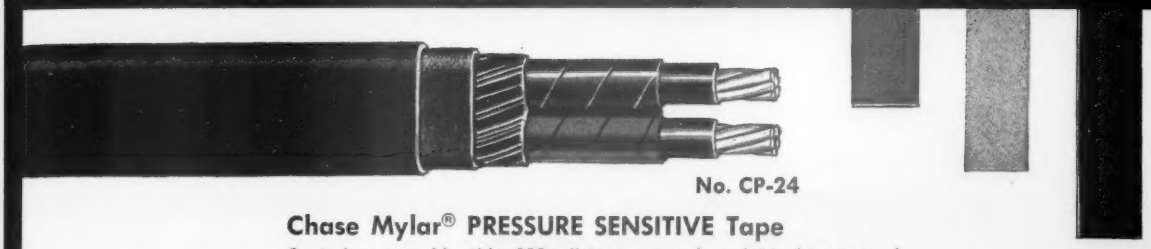
JAMES L. ENTWISTLE, President

100 GLEN ROAD, CRANSTON 10, R. I., U.S.A. • MAIL P.O. BOX 3674

PHONE HOPKINS 7-8411 • CABLE "JALENCO" PROVIDENCE

If It's NEW in tape
...CHASE HAS IT!

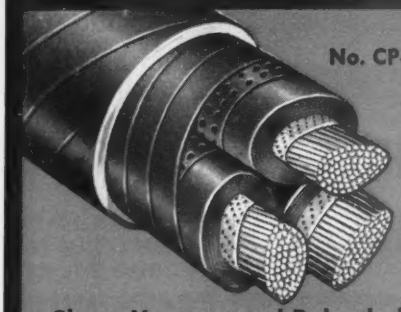
engineered by specialists in electrical insulation



No. CP-24

Chase Mylar® PRESSURE SENSITIVE Tape

Coated on one side, this .002 mil tape comes in red, black or natural. Ideal for moisture seal, heat resistance and color coding.



No. CP-2

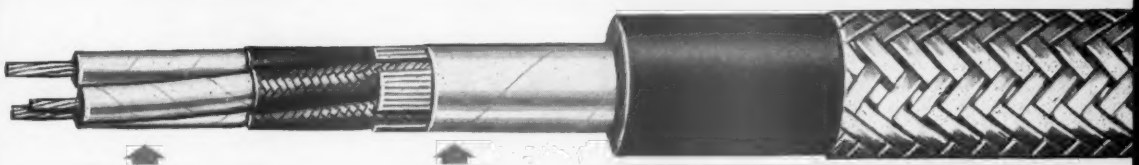
Chase Unsupported Polyethylene Pressure Sensitive Tape

Becoming more and more popular as an electrical insulation, this .014 mil flexible tape is excellent as a moisture seal.

No. CP-11

Chase Teflon® Pressure Sensitive Tape

Pressure sensitive on one side and made of glass fabric coated with Teflon® for high heat resistance and dielectric strength, this new .007 mil tape provides the absolute moisture seal.



No. HH-7 SILICONE TAPE

No. L-219 REINFORCED ASBESTOS TAPE

A Natural Pair

Chase No. HH-7 Cured Silicone Coated Glass Fabric tape for insulation and No. L-219 Glass Reinforced Asbestos Tape as a binder-barrier shown here on Type TSGA Navy Cable.

Send For Details & Samples

®Mylar and Teflon are registered trade marks of duPont.

CHASE & SONS INC.

26 Spruce Street, North Quincy, Mass.

Please send details & samples of

☐ Chase No. CP-24 ☐ No. CP-2 ☐ No. CP-11 ☐ No. HH-7 ☐ No. L-219

NAME..... TITLE.....

COMPANY.....

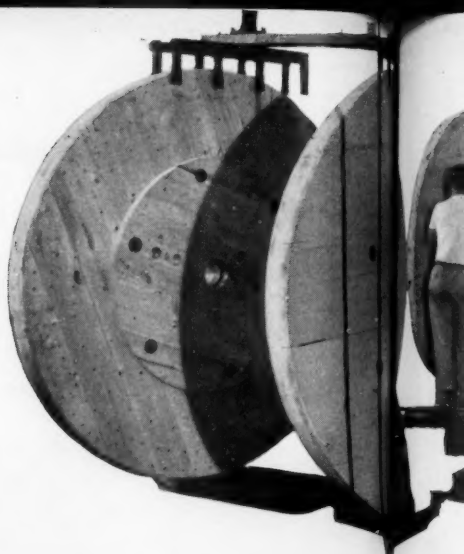
STREET.....

CITY..... STATE.....

BRIDGE

MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT
Telephone . . .
Thompsonville, Connecticut
Riverview 9-8308

Saw mill at Bradford, N. H., where logs are processed into lumber.



Interior of the Kearsarge plant.

Plant of Kearsarge Reel Co. — an affiliate of Bridge Manufacturing Co.

Interior of Hill mill showing manufacture of panels for reel heads.

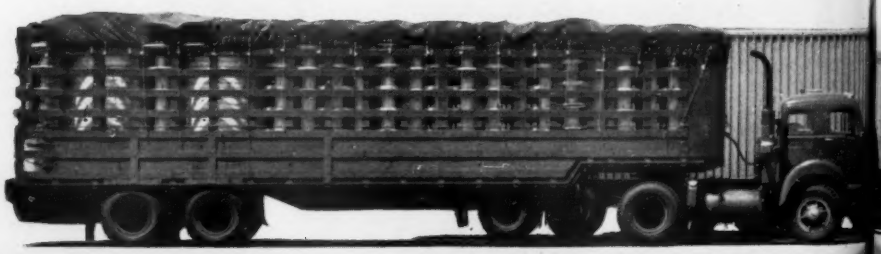
Hill Box Company's panel mill — another BRIDGE affiliate.

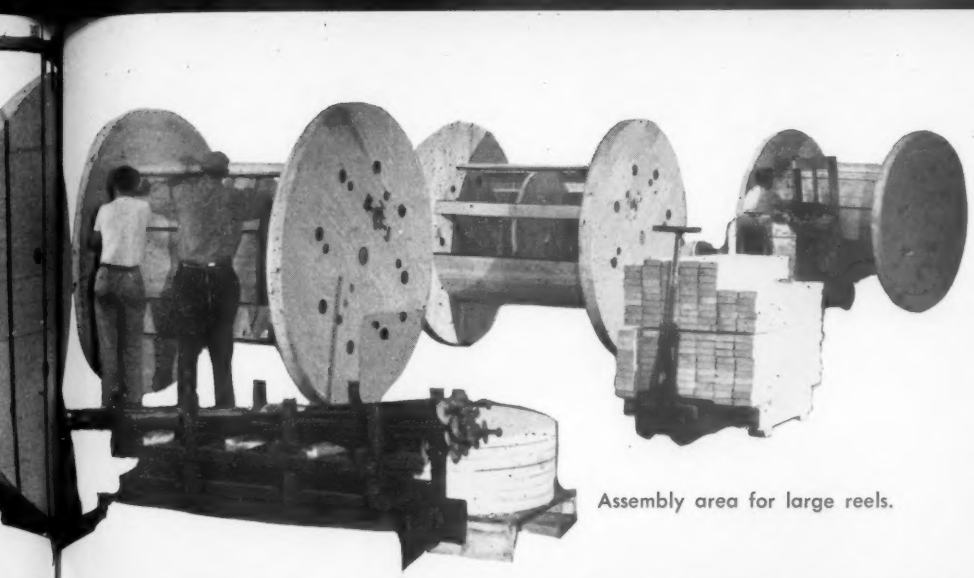
HOW BRIDGE SUPPLIES ONLY THE BEST REELS

Our company is old, but progressive. Since we began the manufacture of wood reels for wire, rope and electric cable, our plant has undergone a continuous process of expansion and improvement in production facilities — all to the end of making the finest reels and of reducing fabricating costs — listed are some of the factors entering into our ability to serve wire mills effectively and well.

Planing and cutting round-edge lumber

HIGH-SPEED SHIPPING SERVICE IN OUR OWN FLEET OF TRUCKS WITHIN A RADIUS OF 250 MILES FROM THE PLANT.

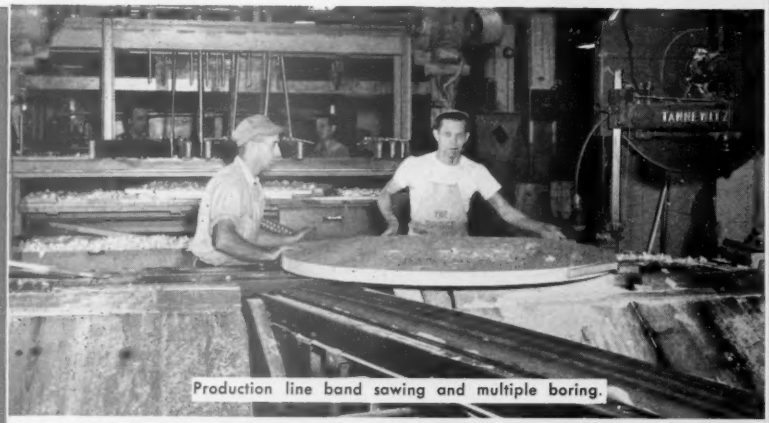




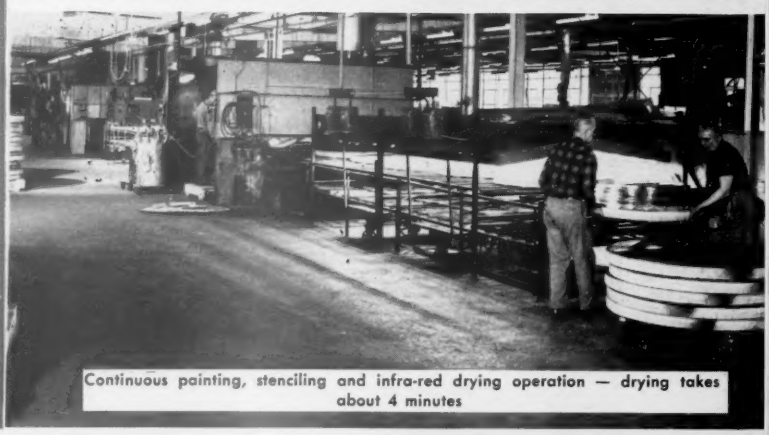
Assembly area for large reels.

Start of production line for reel flange

- CONTROLLED SAW MILL OPERATIONS.
- CONVERSION OF LUMBER INTO PANELS AND SQUARE-EDGE LUMBER.
- MILLIONS OF BOARD FEET OF LUMBER ALWAYS IN INVENTORY.
- AIR SEASONING OF LUMBER — SUPPLEMENTED BY KILN DRYING.
- EFFICIENT, MODERN MATERIAL HANDLING EQUIPMENT FROM FOREST TO FINISHED REEL.
- LATEST AND FINEST REEL MANUFACTURING MACHINES—MANY MADE TO BRIDGE DESIGNS AND SPECIFICATIONS.
- FABRICATING METHODS CONTINUOUSLY IMPROVED.
- FAST, EFFICIENT STRAIGHT-LINE PRODUCTION FLOW OF WORK.
- PAINTING AND STENCILING COMPLETED IN APPROXIMATELY 4 MINUTES.
- REEL ASSEMBLY METHODS EMPLOY MANY MECHANICAL INNOVATIONS.
- OVERNIGHT DELIVERIES IN OUR OWN TRAILER TRUCKS. FAST FREIGHT USED FOR DISTANT POINTS.



Production line band sawing and multiple boring.



Continuous painting, stenciling and infra-red drying operation — drying takes about 4 minutes

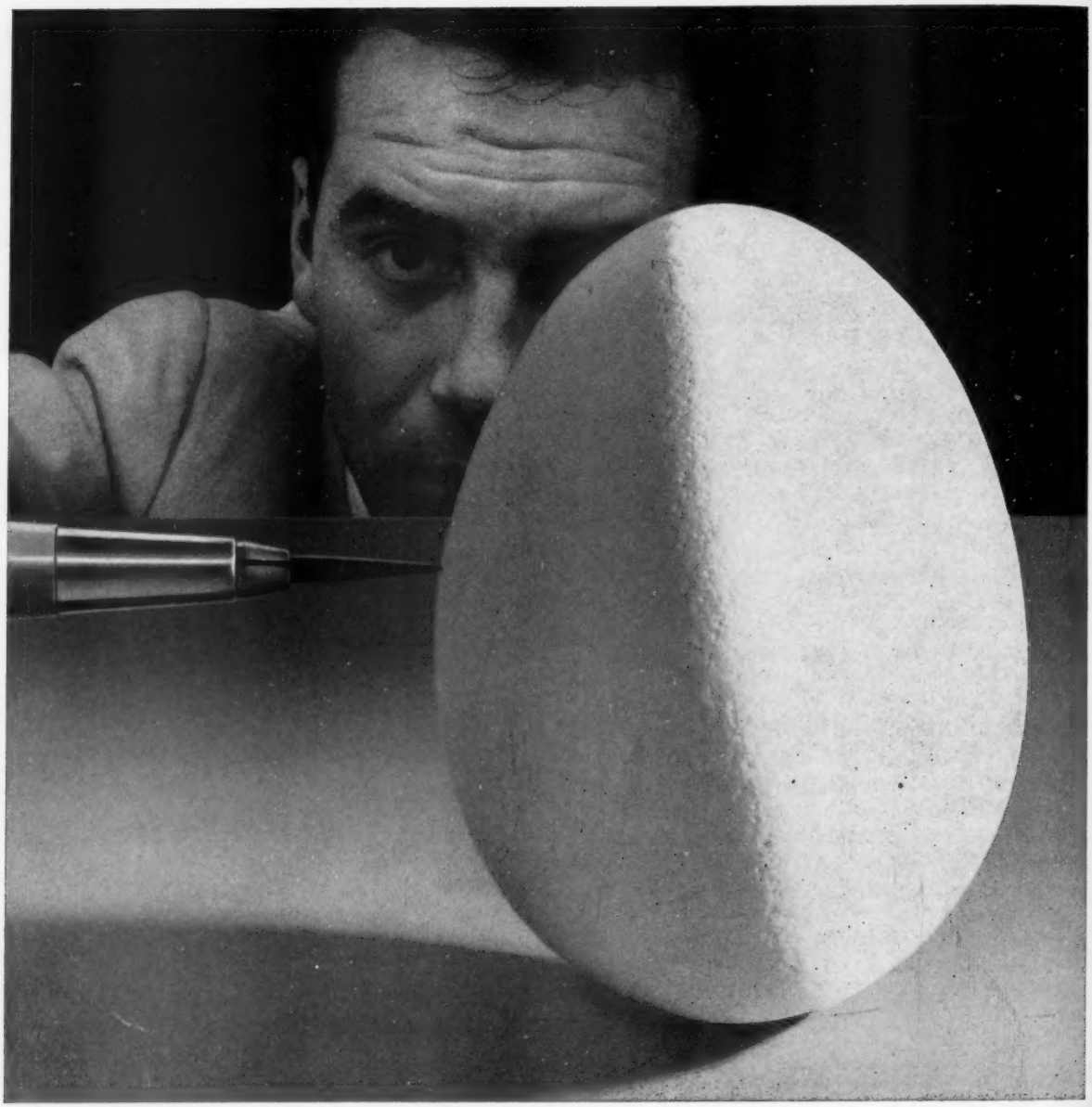
LET US QUOTE YOU ON YOUR REEL NEEDS. SEND US YOUR SPECIFICATIONS. OR BETTER — VISIT OUR PLANT AND SEE HOW BRIDGE REELS ARE MADE.

BRIDGE

MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT
Telephone . . .
Thompsonville, Connecticut
Riverview 9-8308

Small reel bench assembly and loadin

A delicate problem . . .

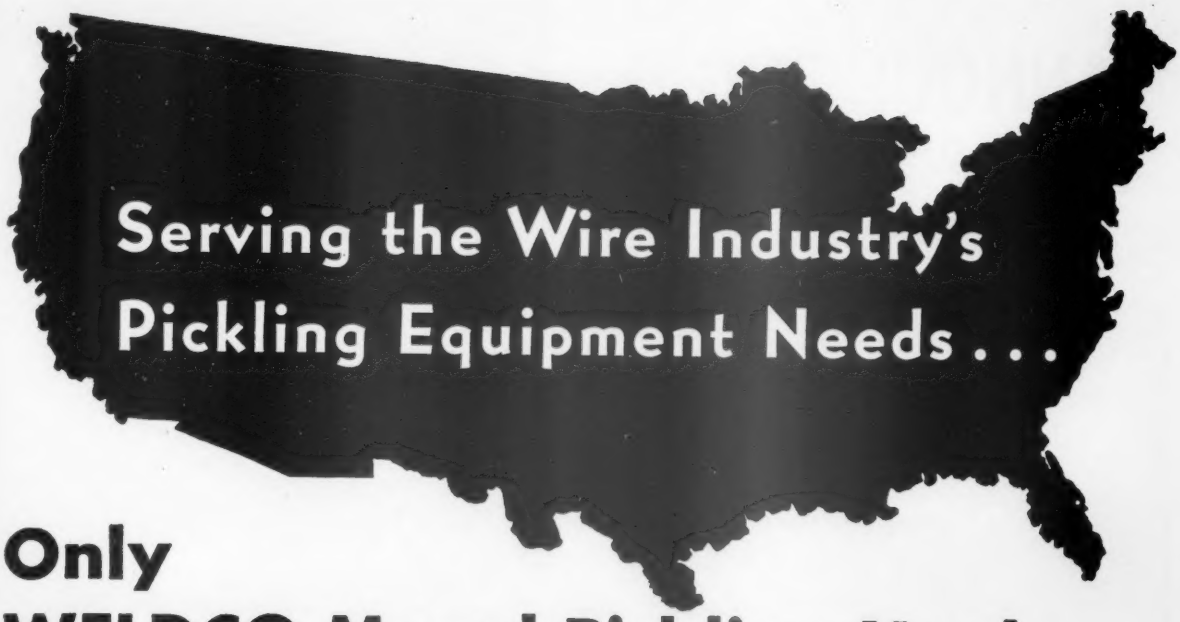


SCHLATTER

For over 40 years we have been specializing in all kinds of welding problems. New solutions are constantly being found in close co-operation with our customers all over the world. Our great experience may also assist you in solving a particularly delicate problem. Especially for the wire industry, machines and complete installations have been built – from the smallest wire butt welder to the largest wire mesh welding plant – unique in their technical conception and performance-tested in everyday use.
Therefore, do not look for the "Egg of Columbus" – let our engineers and technicians study your problems.

Representative for Canada and USA
R. REICHER - Machinery and Equipment
600 Eglinton Ave., East,
Toronto 12, Ont., Canada

H. A. SCHLATTER LTD. ZOLLIKON-ZURICH (SWITZERLAND)
ELECTRIC WELDING MACHINES AND ELECTRONIC CONTROLS



Only WELDCO Monel Pickling Hooks Have Such Universal Acceptance!

OTHER WELDCO PICKLING EQUIPMENT

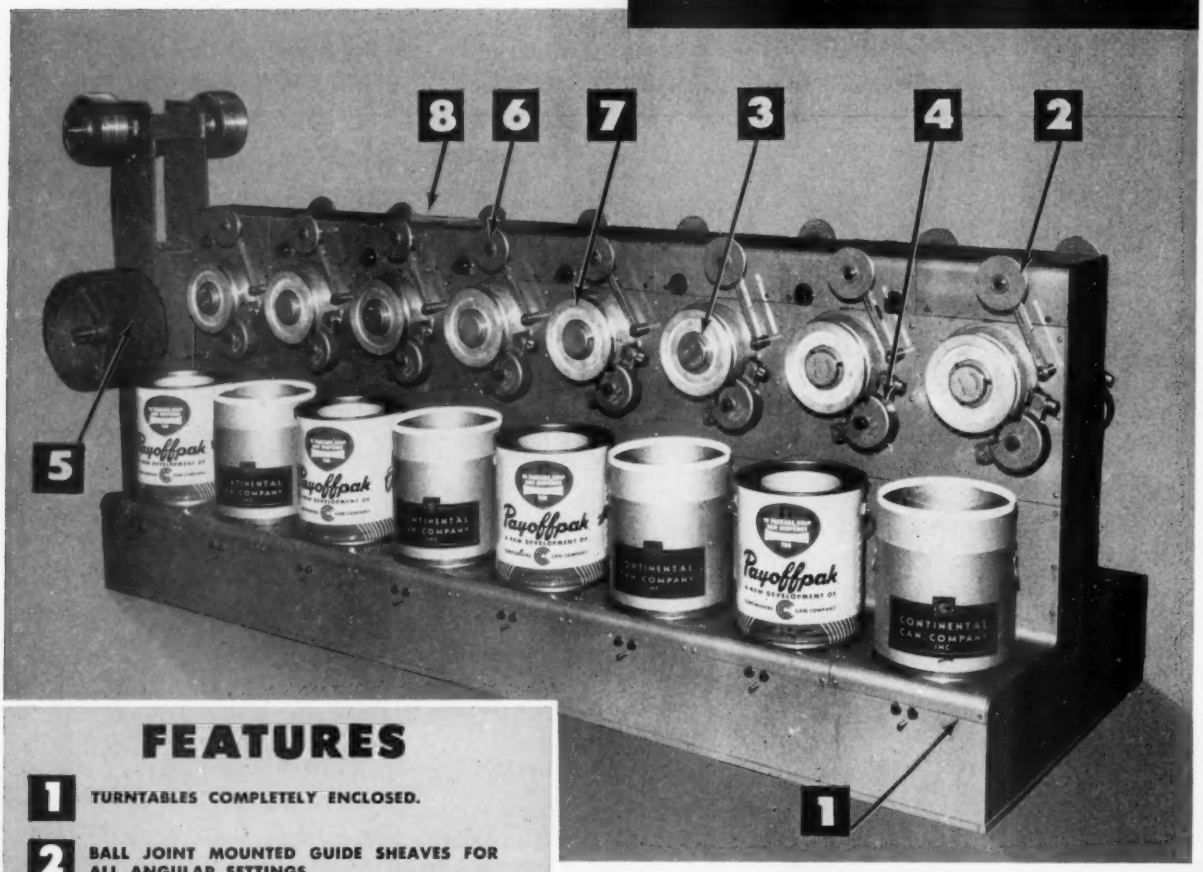
Mechanical Picklers,
Crates, Baskets,
Racks, Chain,
Steam Jets,
and Accessories

WELDCO

American Steel & Wire Company - - - - - - Donora, Pa.
American Steel & Wire Company - - - - - - - Joliet, Ill.
American Steel & Wire Company - - - Worcester, Mass.
Bethlehem Steel Company - - - - - Sparrows Point, Md.
Bethlehem Steel Company - - - - - - Williamsport, Pa.
Detroit Steel Corporation - - - - - - - Portsmouth, Ohio
Electric Auto-Lite Company - - - - - - Port Huron, Mich.
Indiana Steel & Wire Company - - - - - - Muncie, Ind.
Johnson Steel & Wire Co. - - - - - - - Worcester, Mass.
Jones & Laughlin Steel Corporation - - - - Aliquippa, Pa.
Keystone Steel & Wire Company - - - - - - - Peoria, Ill.
Lamson & Sessions Company - - - - - Cleveland, Ohio
National Screw & Manufacturing Co. - - Cleveland, Ohio
Pittsburgh Steel Company - - - - - - - - Monessen, Pa.
John A. Roebling's Sons Corporation - - Roebling, N. J.
Timken Roller Bearing Company - - - Gambrinus, Ohio
Union Drawn Steel Division - - - - - - Massillon, Ohio
Washburn Wire Company - - - - - - - New York, N. Y.
Wickwire Spencer Steel Division - - - - - Buffalo, N. Y.

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY
3724 OAKWOOD AVENUE · · YOUNGSTOWN 9, OHIO

ANNOUNCING the WYREPAK



FEATURES

1. TURNTABLES COMPLETELY ENCLOSED.
2. BALL JOINT MOUNTED GUIDE SHEAVES FOR ALL ANGULAR SETTINGS,
3. ELECTRO-MECHANICAL TENSION CONTROL FOR EACH HEAD.
4. PRECISION GROUND PRESSURE ROLLS.
5. PRIME RUBBER LAGGED CAPSTAN.
6. ASSEMBLED AND ALL ADJUSTMENTS MADE WITH ALLEN SCREWS.
7. ALUMINUM CAPSTANS, WITH HARD-ANODIZED, POLISHED RUNNING SURFACES.
8. INDIVIDUAL MAINTENANCE ON EACH SECTION.

The drum packaging Take-Up System illustrated, Model S5-TC-S, was designed especially for Magnet Wire.

Other models are made for all types of ferrous and non-ferrous wires.

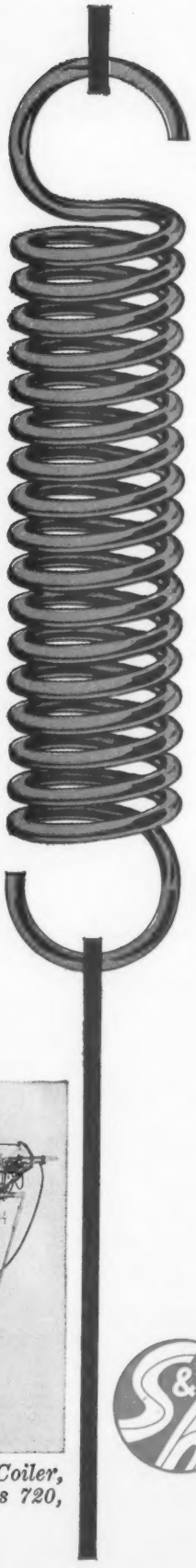
Advanced engineering and precision construction have evolved in this machine new concepts of speed and efficiency in the packaging of wire. Capacity: Min. size — #32 ga.; max. size — #20 ga. wire.

YOU ARE INVITED TO SECURE COMPLETE DETAILS REGARDING THIS ADVANCED PROCESS FROM —

Advanced Wyrepak Co., Inc.

11 HARRISON COURT PHONE: EDison 4-4274 BRIDGEPORT, CONN.

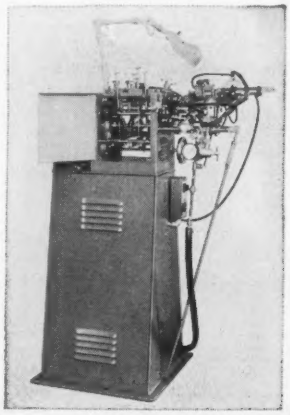
OR The Vaughn Machinery Co., CUYAHOGA FALLS, OHIO



NOW COIL and LOOP
IN ONE OPERATION
AUTOMATICALLY

Here's a completely new combination spring coiling and looping concept that does away with all secondary operations. It will automatically produce accurately formed extension springs with both ends looped. It is designed as an attachment for the S&H #0 Universal Spring Coiler, Escapement Type. The unit is capable of handling springs ranging in length from four coils up to the maximum wire feed capacity of the coiler.

Find out how this S&H combination unit can help you with your volume spring production. Write, Wire or Phone Collect for further information—Today.



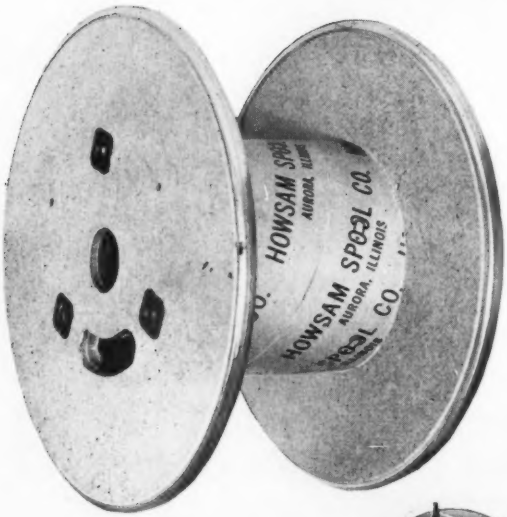
No. 0 Universal Spring Coiler, Escapement Type, Series 720, with Automatic Looper

SLEEPER & HARTLEY INC.
335 CHANDLER STREET
WORCESTER 1, MASS., U.S.A.

ORIGINAL MANUFACTURERS OF UNIVERSAL SPRING COILERS

HOWSAM REELS ARE . . . . .
STRONG—WELL-MADE

TWO HOWSAM Metal-Bound Reels are described below



12 Inch No Charge Reel with Hardboard Head. Pictured at right is the reel with one head removed to show triangle bracing.

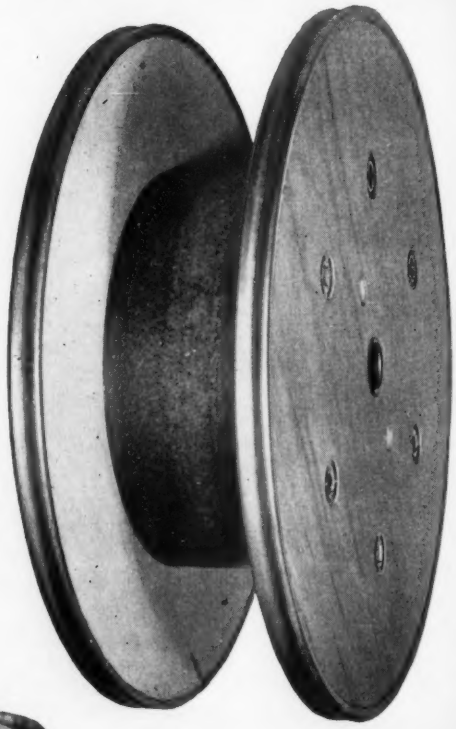
12" HEAD NO CHARGE REEL

Heads are hardboard, metal-bound. Hub is recessed into heads for tight joint and true running reel.

Triangle bracing placed inside of hub and between the heads helps retain the traverse width and reduce dishing of the heads.

Fasteners used to assemble the reel are of the ratchet plate type, which maintain a constant pressure on the heads.

Metal-bound heads have been used in reel construction for many years and have proven their value.



The 24 Inch Metal-Bound Plywood Head Reel. Triangle bracing is shown at the left.

24" METAL-BOUND PLYWOOD HEAD REEL

Another first in reel construction.

A one-piece hub made of hardwood with only one seam, which is held tight by a splice on the inner side leaving a smooth uninterrupted winding surface.

A one-piece hub helps reduce racking of the reel should the fasteners become loose.

Expansion and shrinkage are reduced to a minimum maintaining a tight joint between the head and hub.
No fillets at the hub and head joint.

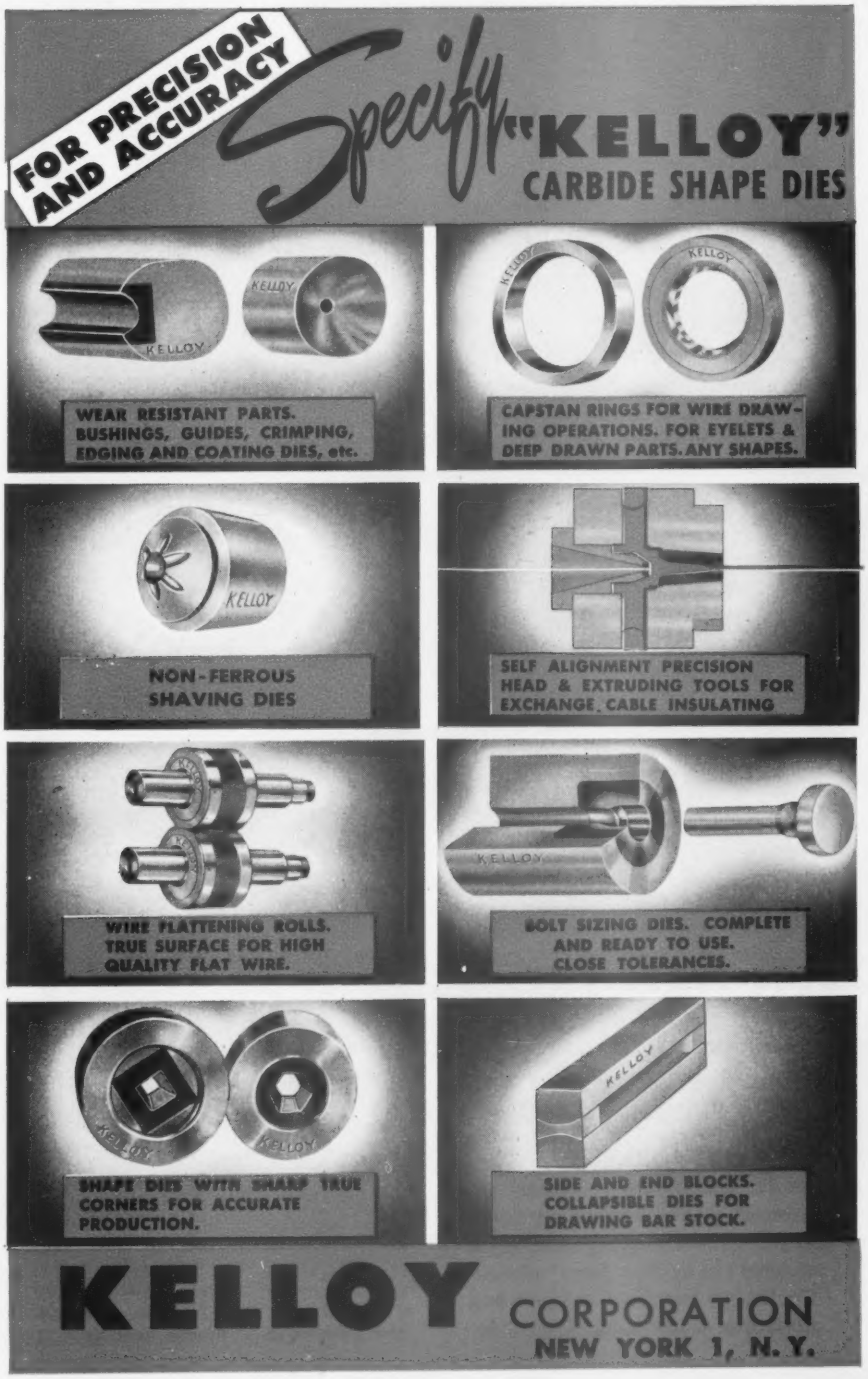
Triangle braces placed inside the hub and between the heads reduce the possibility of the heads being moved out of alignment from shock.

HOWSAM was the first to introduce **"PRESSURE PAD"** Fasteners*
Welded Steel Ferrule in the arbor hole And now — a Hardboard Hub.
For further details, write

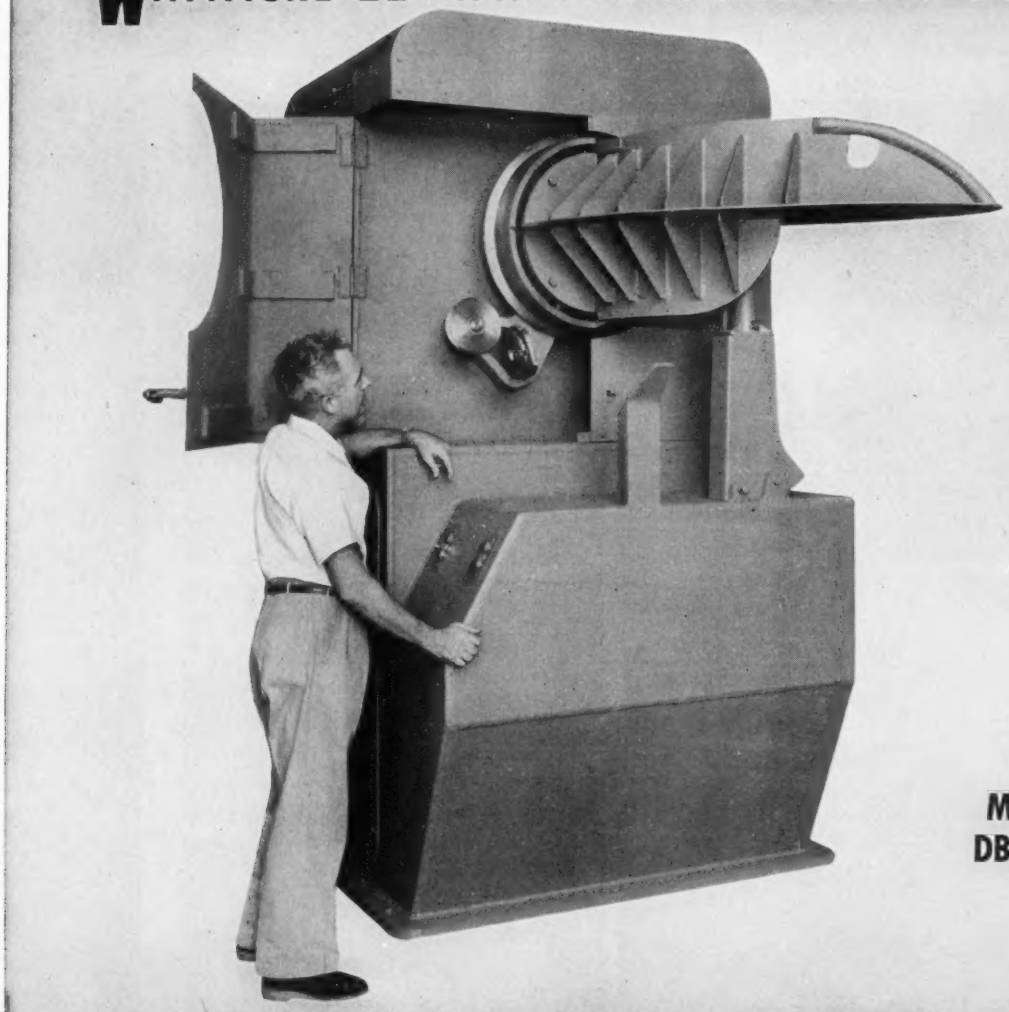
HOWSAM SPOOL COMPANY

* Registered

500 Rathbone Avenue **Aurora, Illinois**


FOR PRECISION AND ACCURACY
Specify "KELLOY"
CARBIDE SHAPE DIES
KELLOY
WEAR RESISTANT PARTS. BUSHINGS, GUIDES, CRIMPING, EDGING AND COATING DIES, etc.
CAPSTAN RINGS FOR WIRE DRAWING OPERATIONS. FOR EYELETS & DEEP DRAWN PARTS. ANY SHAPES.
NON-FERROUS SHAVING DIES
SELF ALIGNMENT PRECISION HEAD & EXTRUDING TOOLS FOR EXCHANGE. CABLE INSULATING
WIRE FLATTENING ROLLS. TRUE SURFACE FOR HIGH QUALITY FLAT WIRE.
BOLT SIZING DIES. COMPLETE AND READY TO USE. CLOSE TOLERANCES.
SHAPE DIES WITH SHARP TRUE CORNERS FOR ACCURATE PRODUCTION.
SIDE AND END BLOCKS. COLLAPSIBLE DIES FOR DRAWING BAR STOCK.
KELLOY CORPORATION
NEW YORK 1, N. Y.

WHITACRE 22″ WIRE DRAWING DEAD BLOCK



Model
DB-22A

Continuous Production—Efficiency Approaching 100%

Gives you these advantages

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

OTHER MODELS AVAILABLE

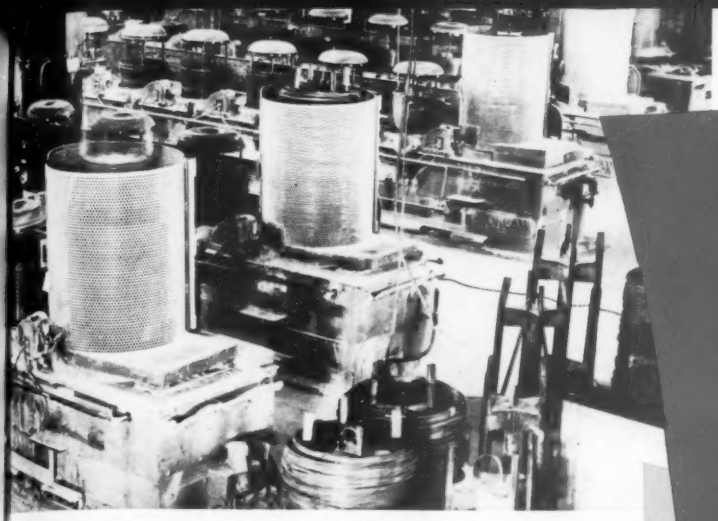
16″ Wire Drawing Dead Block, Model DB-16A • 26″ Wire Drawing Dead Block, Model DB-26A • Combination 16″ and 22″ Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26″ Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

Write Today For Specifications And Name Of Nearest Distributor

WHITACRE ENGINEERING & MANUFACTURING COMPANY

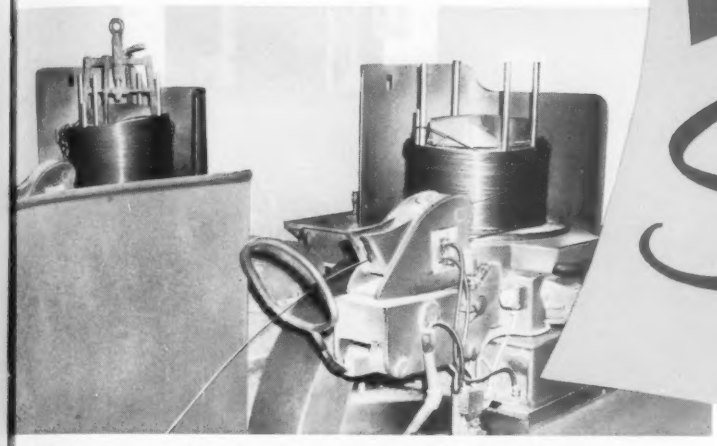
5649 ALHAMBRA AVENUE • LOS ANGELES 32, CALIFORNIA • CAPITOL 5-2476

WHITACRE



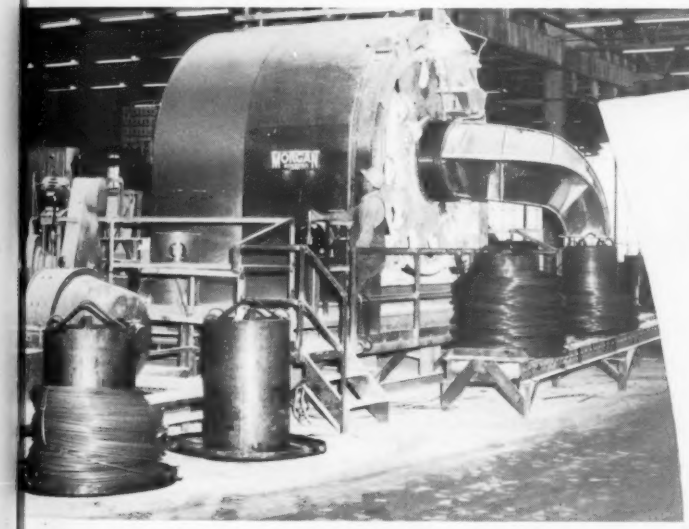
Laclede Steel Company Alton, Illinois

For Quality Production



Wickwire Spencer Steel Division, Colorado Fuel and Iron Corp.
Palmer, Massachusetts

Specify



Sheffield Division, Armco Steel Corp.
Bolt and Forged Products Plant Kansas City, Missouri

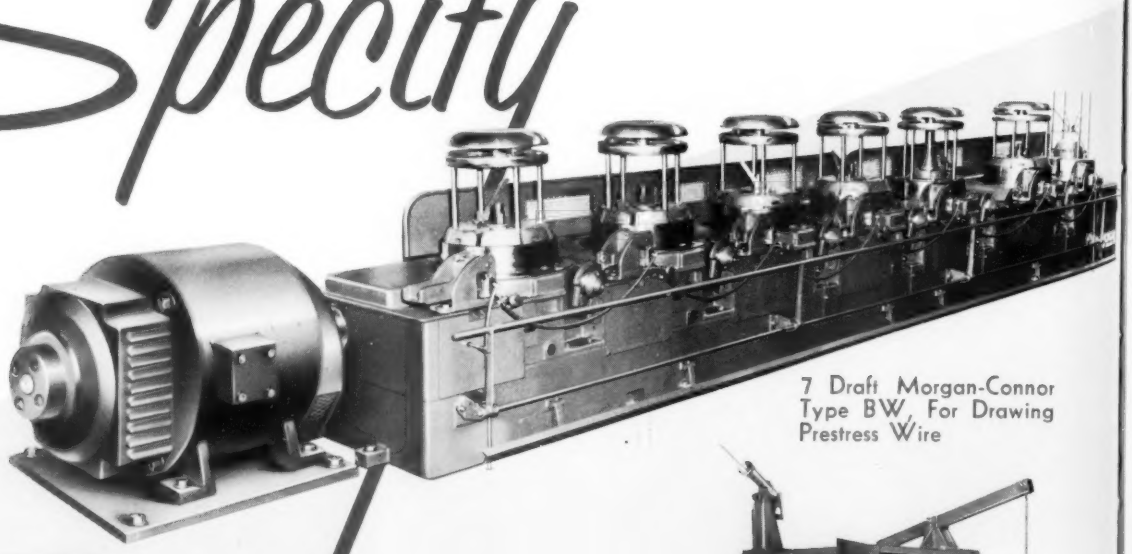
MORGAN WIRE DRAWING MACHINES

Production-wise wire manufacturers select Morgan Wire Drawing Machines because of their proven record of high volume—top quality production. Further proof of Morgan Machine effectiveness is shown by the number of repeat orders by users. Let us show you how Morgan Wire Drawing Machines can do a better job for you.

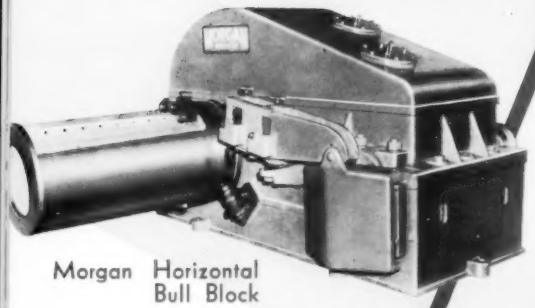
SEE THE OTHER SIDE, PLEASE

FOR HIGH PERFORMANCE

Specify

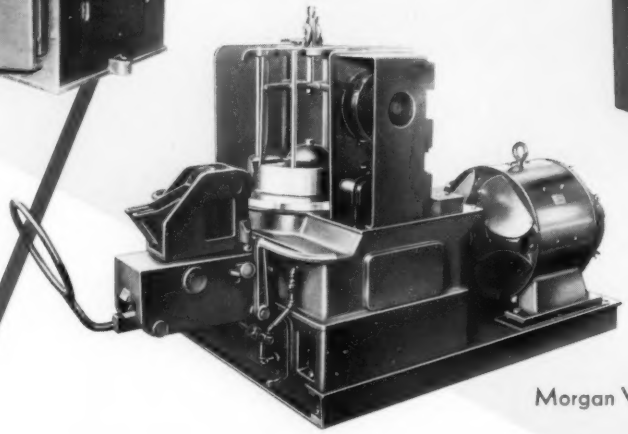


7 Draft Morgan-Connor Type BW, For Drawing Prestress Wire



Morgan Horizontal Bull Block

Morgan Dead Block For Drawing



Morgan Vertical Wire Block

MORGAN

WIRE DRAWING MACHINES

Morgan Construction Company WORCESTER, MASS.

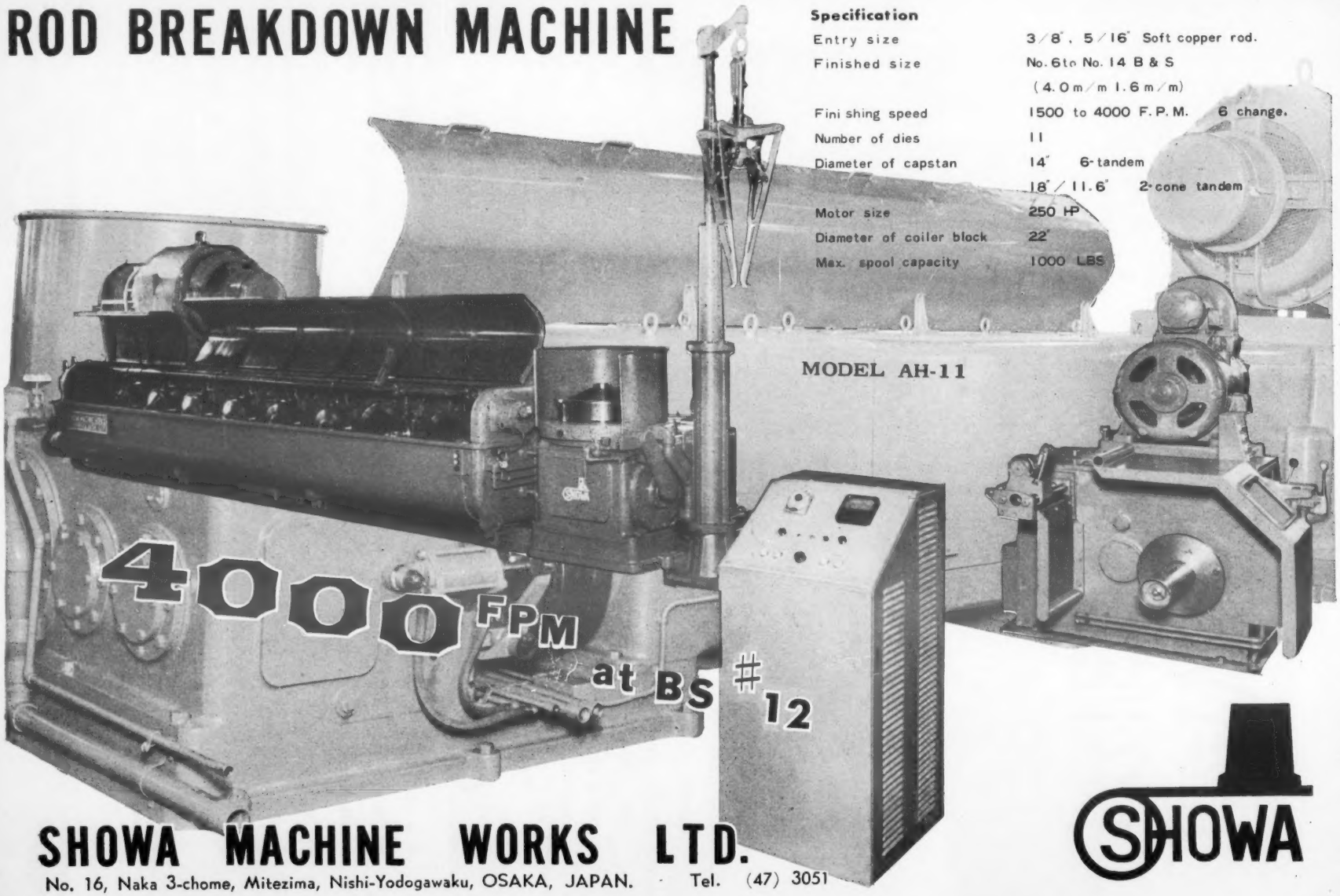
ROLLING MILLS • MORGOIL BEARINGS • REGENERATIVE FURNACE CONTROL • EJECTORS • GAS PRODUCERS

ROD BREAKDOWN MACHINE

Specification

Entry size	3/8", 5/16" Soft copper rod.
Finished size	No. 6 to No. 14 B & S (4.0 m/m 1.6 m/m)
Fini shing speed	1500 to 4000 F. P. M. 6 change.
Number of dies	11
Diameter of capstan	14" 6-tandem
	18"/11.6" 2-cone tandem
Motor size	250 HP
Diameter of coiler block	22"
Max. spool capacity	1000 LBS

MODEL AH-11



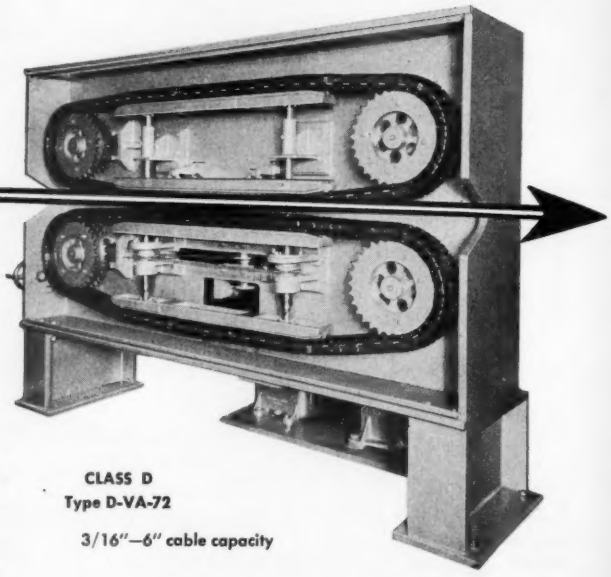
SHOWA MACHINE WORKS LTD.

No. 16, Naka 3-chome, Mitezima, Nishi-Yodogawaku, OSAKA, JAPAN. Tel. (47) 3051

SHOWA

HAVE YOU TRIED

STRAIGHT PULL



CLASS D
Type D-VA-72

3/16"—6" cable capacity

IF NOT . . .

You have been compromising product quality as well as having been subjected to the high initial cost, complex installation, wasted floor space and exorbitant power requirements inherent to drum type capstans.

FOR YOUR NEW INSULATING LINE . . . CONSIDER

CATERPULLER* *by ENTWISTLE*

It is notable that Caterpuller, including drive, costs less and requires no special pit or foundation. In addition to these savings, undue flexing of cables is eliminated, while heavier pulls are possible with less horsepower.

The D-VA-72 Caterpuller, pictured above, is a prime example of the many fine types of Caterpullers by ENTWISTLE covering a wide range of applications. Without obligation, write for Specification No. 16.

*TRADEMARK

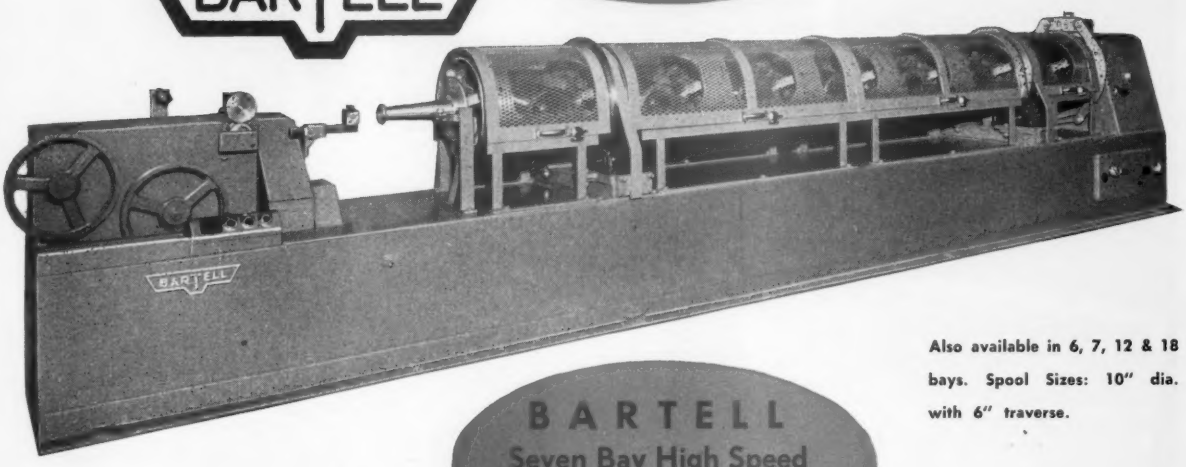
ENTWISTLE
Manufacturing Corporation
1475 ELMWOOD AVE., PROVIDENCE 7, RHODE ISLAND
Over 40 years of dependable service
Formerly James L. Entwistle Co.

Europe, South America, Mexico
FOREL EQUIPMENT CORPORATION
165 Broadway, New York 6, N. Y.

British Associates
THE KEMSON ENGINEERING CO., LTD.
Wellington Mill, Bolton Road
Blackburn, Lancs., England

FOR THE BEST

BARTELL



Also available in 6, 7, 12 & 18 bays. Spool Sizes: 10" dia. with 6" traverse.

BARTELL
Seven Bay High Speed Strander
Model 7B-58-15

Frames are constructed of hot rolled shapes and plates to form a rigid box structure — Barrel is extruded 6062T-6 aluminum — Smooth starts through slip clutch driven by 7½ H.P. motor — Operators control station at front of machine — Main power control center at drive end — Electronically controlled automatic stop energizes solenoid operated brakes in event of wire breakage — Spool cradles and associated parts are completely interchangeable from one machine to another — Tungsten carbide wire guides throughout — Lay from ¼ in. to 5 in. long.

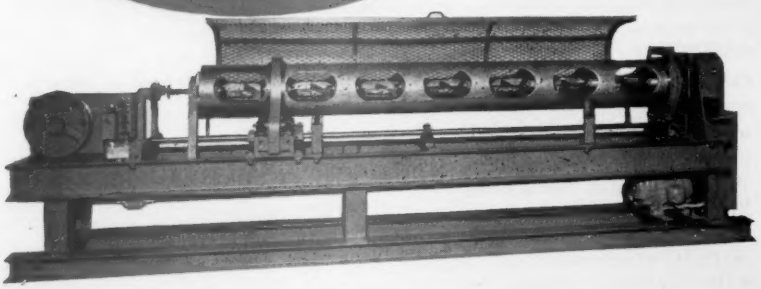
• CATERPILLAR CAPSTANS • SINGLE & MULTIPLE HEAD RESPOOLERS • WIRE STRANDERS
• TAKE-UP & PAY-OFF STANDS FOR PLATING EQUIPMENT

BARTELL

WE ALSO DESIGN AND BUILD SPECIAL EQUIPMENT TO MEET SPECIFIED REQUIREMENTS.

BARTELL
Seven Bay High Speed Strander
Model 7 B 55

This precision, perfectly balanced machine features: rigid steel box structure-barrels of high strength ALCOA alloy — motor mounted below center of gravity — safe, positive drive — push button controls — carbide wire guides — interchangeable cradle assemblies — standard cradles taking 7" diam. X 4" Traverse Spools — 30 lengths of lay.



BARTELL MACHINE-TOOL CORP.
★ Designers ★ Manufacturers ★ Engineers ★ Consultants
YACHT CLUB ROAD ROME, N. Y.

NOMINAL WEIGHTS OF FINISHED WEATHER-RESISTANT WIRE AND CABLE
Copper & Copper Alloy Conductors
Aluminum Conductors
Conductor Size AWG or Mcm
LIRC Type Double Braid
LIRC Type Triple Braid
Neoprene Type
Polyethylene Type
Neoprene Type
Polyethylene Type
Stranded
Solid
This table shows
POLYETHYLENE covere
I HAD THE BOSS UP A POLE...
DON'T GET ME WRONG...I STILL DON'T LIKE STORMS
"But they don't seem to hit us so hard any more.
Not since polyethylene coated wire came along."

TELLING THE POLYETHYLENE WIRE STORY CAN BUILD FUTURE PROFITS FOR YOU

Polyethylene-covered line wire has many advantages for users: Exceptional weather and stress-crack resistance. Easy handling and installation. Long life in service. Fewer outages and minimum maintenance.

We've been telling your customers the polyethylene story in utility magazines through advertisements like those above. And more and more users are specifying polyethylene covering for line wire and many other applications. Why not join us in this effort?

Polyethylene can make your operations simpler, with a more profitable future too.

- The resin comes ready-to-use — nothing to add, no blending, no milling, no post-extrusion vulcanizing. With production based completely on polyethylene, one line replaces several, providing savings in equipment, floor space, maintenance and labor. And there's only one material to purchase and inventory.
- Unlike costs of other insulating materials, which are trending upward, polyethylene price history promises long-term stability. This means polyethylene can be expected to be your most profitable line wire coating in the years ahead.

You can build a solid base for future sales and increased profits by promoting polyethylene line wire now among your customers and prospects.

As you make recommendations, you will find our new data sheet, "PETROTHENE® Resins for Wire and Cable Industry", helpful in selecting resins with the proper balance of properties for different applications. Also available is U.S.I.'s comprehensive 100-page "PETROTHENE Polyethylene . . . A Processing Guide." Write for your copies.

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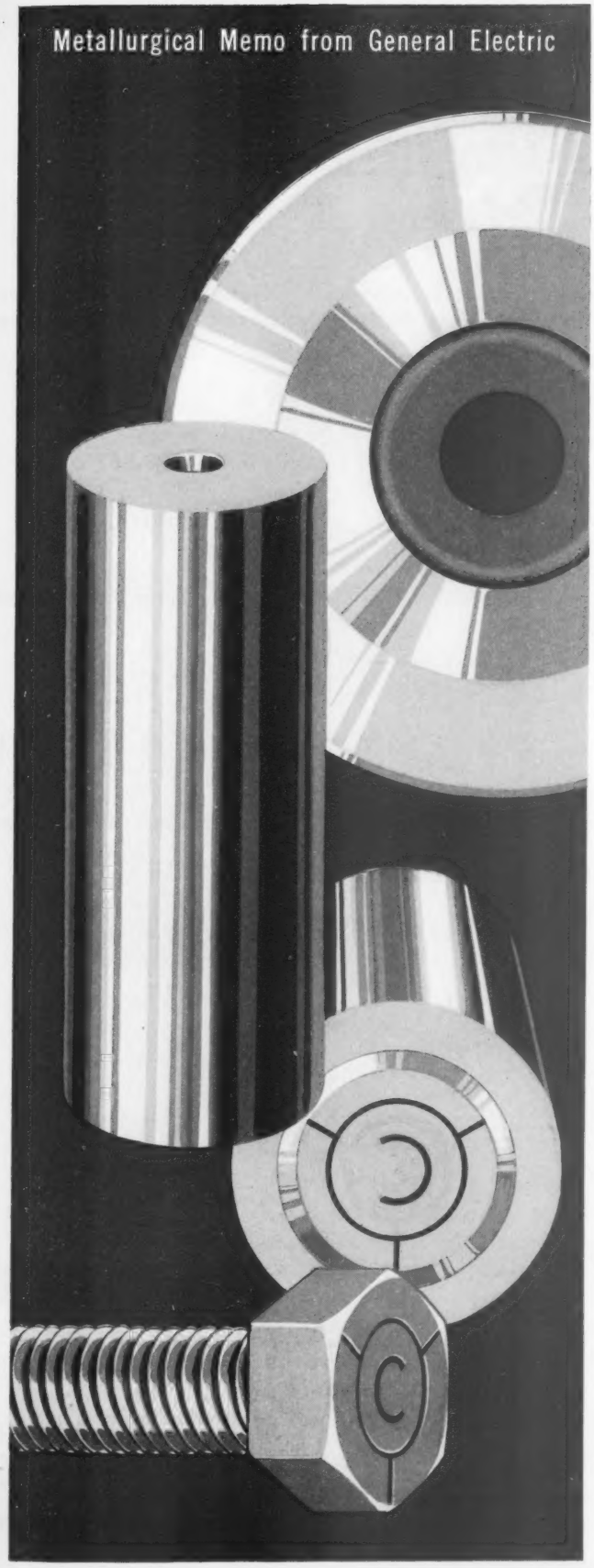

How Carboloy® dies play a part in your profits

Metallurgical Products Department reports on developments that cut wire die costs . . . and on why they are more important today than ever

New applications, techniques, and materials developed in the wire industry demand cemented carbides in dies that can keep pace. And Carboloy wire dies are designed to bring you the advantages of top quality *and* economy!

Carboloy dies—for drawing, extruding, heading, and flattening—reduce costs in several ways. Designed to last longer and turn out pieces of uniform high quality, Carboloy wire dies result in continuous production, minimum reconditioning, less downtime, fewer rejects. Carboloy dies are held to close tolerances to give your products a better finish with less buffing and polishing . . . coupled with absolute conformity to specifications.

These economies—more tonnage per die, improved products, minimum downtime, fewer rejects—combined with low initial cost, make Carboloy wire dies a wise choice when you're looking for reduced expenses AND HIGHER PROFITS!

Why not look into what Carboloy dies offer—there's one to fit your exact need. For further information—or for technical assistance as it relates to your operation—write: *Metallurgical Products Department of General Electric Company, 11171 E. 8 Mile Ave., Detroit 32, Michigan.*

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CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT
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CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • VACUUM-MELTED ALLOYS
THERMISTORS • MAGNETIC MATERIALS • THYRITE®

TINSELS
ALL TYPES AND SIZES

BARE ELECTRIC TINSEL CONDUCTORS

Used in cords for: Telephones — Radios — Electric Shavers — Hearing Aids. Used bare for voice coil lead wires on loud speakers.

SILVER COATED COPPER WIRE

For Stranded Cables. ASTM Designation B 298-55T

TINSEL LAME (FLAT WIRE)

Silver and False Gold Coated Copper — Aluminum Slitfoil for Tinsel Ribbons and Garlands.

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For Muffling of Sound
For Air Conditioning and Oil & Gas Filtration and Entrainment
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Cleans Broilers, Grills, Fry Pans
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Write or telephone to Tinsel Headquarters for quotations on your tinsel requirements.

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world wide acceptance

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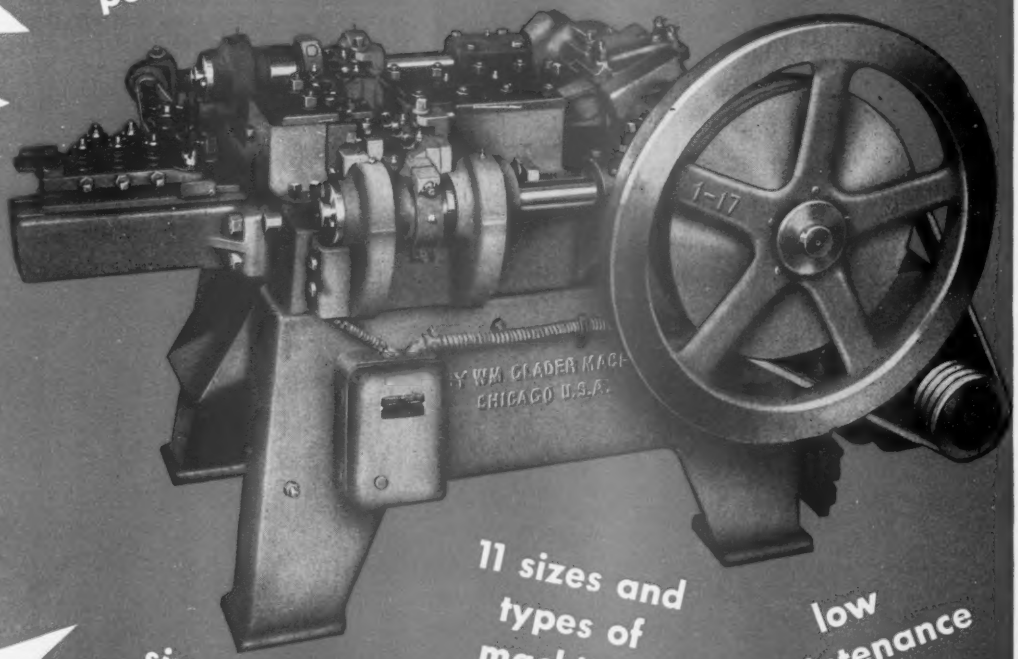
high efficiency



11 sizes and types of machines

low maintenance cost

simplicity of adjustments

rugged construction

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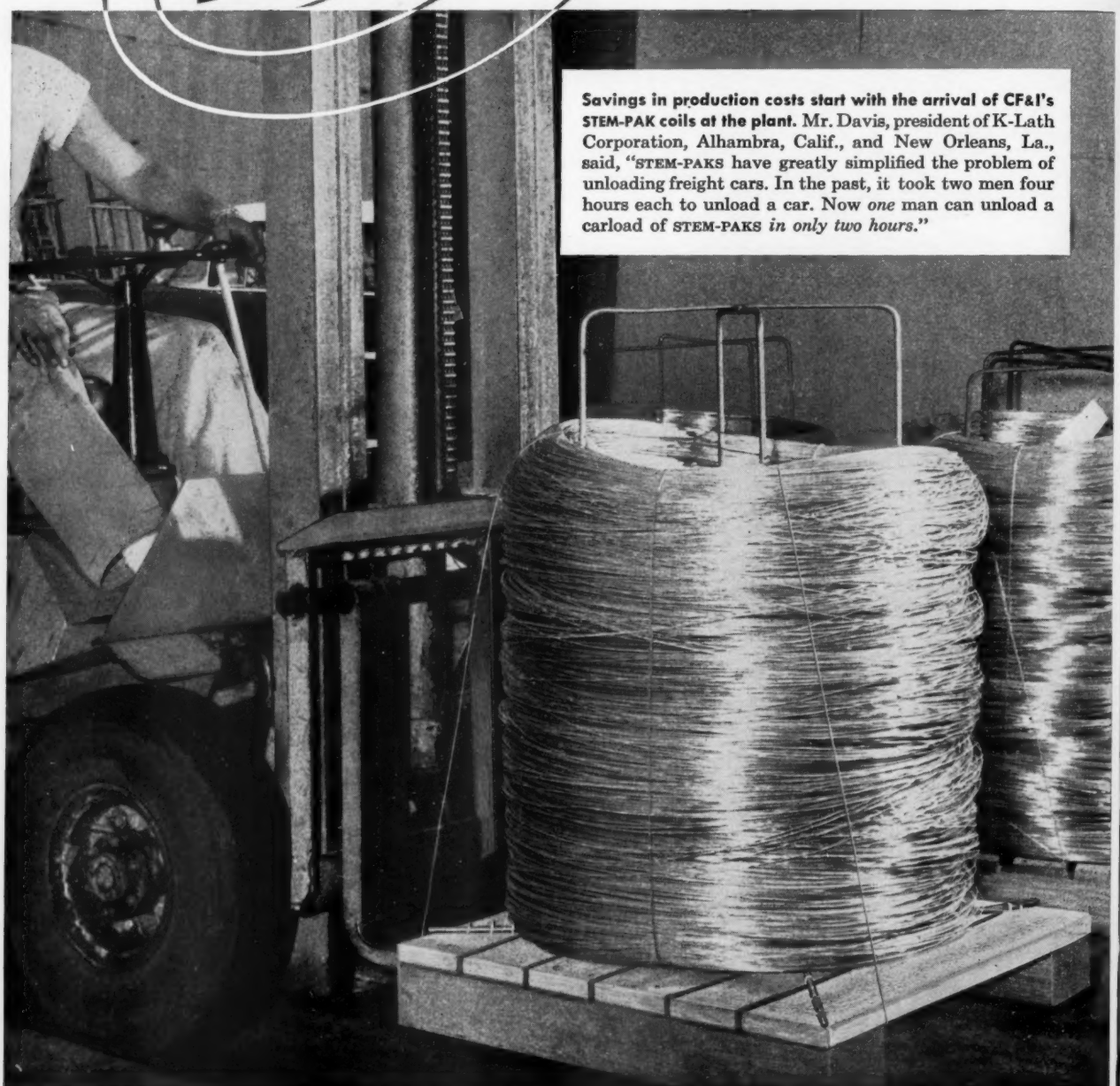
CF&I Wire

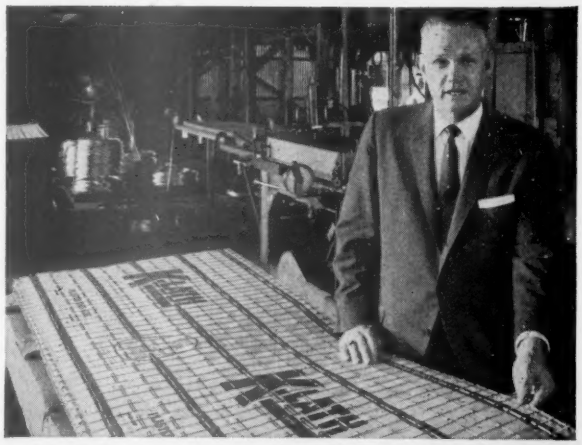
PACKAGED for YOUR PRODUCTION



Savings in production costs start with the arrival of CF&I's STEM-PAK coils at the plant. Mr. Davis, president of K-Lath Corporation, Alhambra, Calif., and New Orleans, La., said, "STEM-PAKS have greatly simplified the problem of unloading freight cars. In the past, it took two men four hours each to unload a car. Now *one* man can unload a carload of STEM-PAKS *in only two hours.*"

helps K-LATH PATENTED increase production 50%

Continuous production achieved by butt-welding the start of a new STEM-PAK to the end of a nearly expended PAK. This change-over takes less than 5 minutes. No machines are stopped. "STEM-PAK'S coils, which hold up to a half-ton of wire, permit us to run each machine as much as 1½ hours longer per day than when we used conventional coils," pointed out Mr. Davis.



K-Lath, an unusual type of lath made of kraft paper reinforced with CF&I Steel Wire, is finding wide acceptance among plastering contractors. "CF&I's clean, galvanized wire helps us to produce a brighter, better-looking product that appeals to contractors," explained Mr. Davis. "CF&I's excellent quality control also assists us in maintaining our own high standards of quality."

problem: "Our production machines are designed for the interlacing of kraft paper with galvanized wire," said Mr. Davis. "As we use about 370 miles of wire daily, our biggest problem was the time lost when we replaced the wire coils feeding our machines. The entire production line came to a halt each time we changed one of the coils."

solution: "Our request for technical assistance from CF&I was answered by a team of engineers," continued Mr. Davis. "These men developed the special STEM-PAKS which have aided us in achieving a continuous operation. Up to 75% of our production downtime — before we began using CF&I products—was caused by using too many small coils. STEM-PAKS hold 800- to 1,000-pounds of continuous, quality galvanized steel wire. These larger packages keep each machine running as much as 1½ hours longer per day. There is a minimum of tangled wire because STEM-PAKS allow free unwinding, without snarling. We have used CF&I STEM-PAKS to increase our production 50%."

Before you order wire, consider your own production problems. Then choose a CF&I wire package that can give you one or more of the following benefits:

- reduced downtime through extra-long lengths of wire
- simplified inventory control
- fast, economical unloading and in-plant handling
- assured cleanliness of the wire

Why not contact our nearest sales office today? Our technicians will be glad to visit you and discuss your packaging requirements.

CF&I—WICKWIRE WIRE

THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Abuquerque • Amarillo • Billings • Boise • Butte Denver • El Paso • Farmington (N. M.) • Ft. Worth • Houston • Kansas City • Lincoln • Oklahoma City • Phoenix Pueblo • Salt Lake City • Wichita • PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • San Leandro • Seattle • Spokane • WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia • CF&I OFFICE IN CANADA: Montreal

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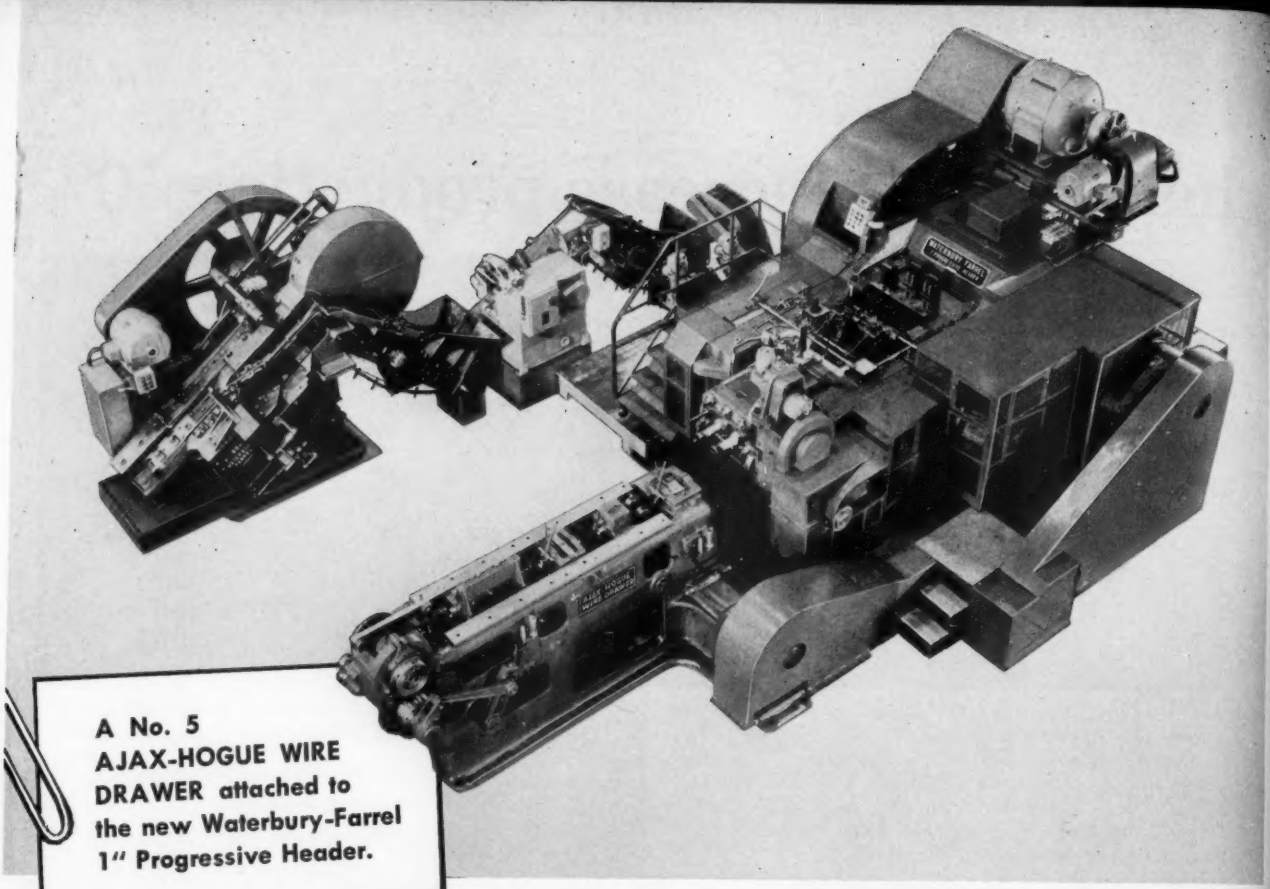
CF&I STEEL



A No. 5 AJAX-HOGUE WIRE DRAWER attached to the new Waterbury-Farrel 1" Progressive Header.

For Quality Production at Lower Cost COLD HEADERS Need . . .

AJAX-HOGUE Wire Drawers

AN ATTACHMENT FOR HEADERS AND COLD NUT FORMERS

THE AJAX-HOGUE WIRE DRAWER is a complete wire drawing unit, custom designed to fit any make cold header or cold nut former. It cold draws wire in a straight line and coats wire from hot-rolled, pickled and limed rod as it feeds into the header. You are sure of uniformly accurate size wire from successive coils. A wire drawer attached to your header assures easier heading, improved products and increased production. *Write for Bulletin 111-A.*

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flawless faster die finishing with scientific compounds

Modern die manufacturers such as New Jersey Carbide Die Co. demand Hyprez, the original Diamond Compound

HYPREZ

High Precision DIAMOND COMPOUNDS

Serving many of the foremost plants in the wire industry, New Jersey Carbide Die Co., of Jersey City, uses Hyprez exclusively for rough finishing, lapping and polishing tungsten-carbide dies.

The continuing preference for Hyprez is built upon Hyprez superiority—maintained by research and control; by fast free-cutting action of pure diamonds precisely graded and uniformly dispersed in scientifically formulated vehicles. Hyprez provides the exact grade and concentration for every job.

for economy of production and for finish to exact specification, New Jersey Carbide Die Co. uses Hyprez exclusively

Ask for a free demonstration or technical bulletin No. HW-109

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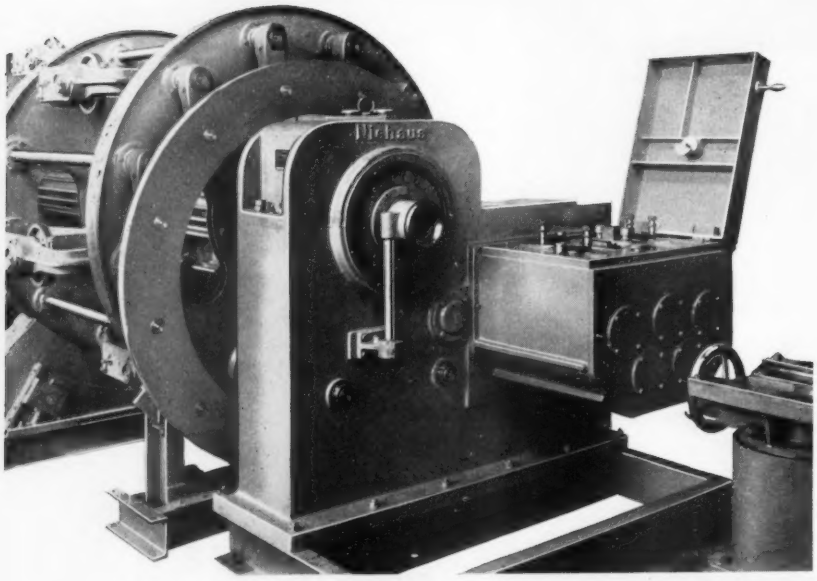
NIEHAUS

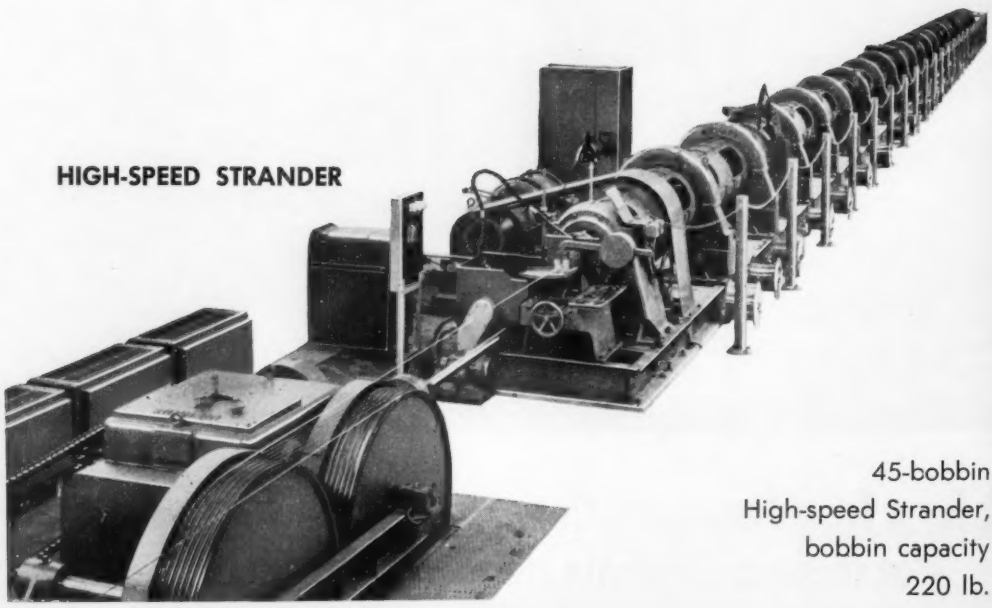
ELECTRIC-CABLE MACHINERY • WIRE-ROPE MACHINERY

PLANETARY STRANDER



We manufacture: Stranding and Rope-closing Machines of tubular and planetary design, of any size and for any number of bobbins, as well as the pertinent auxiliary machinery and equipment.

HIGH-SPEED STRANDER



45-bobbin High-speed Strander, bobbin capacity 220 lb.

MASCHINENFABRIK K. A. NIEHAUS • DUSSELDORF-RATH

Sole Representative: Paul Reicher Machinery & Equipment, 600 Eglinton Ave., East, Toronto 12, Ont., Canada

VERMONT... *the Summit of Good Skiing*

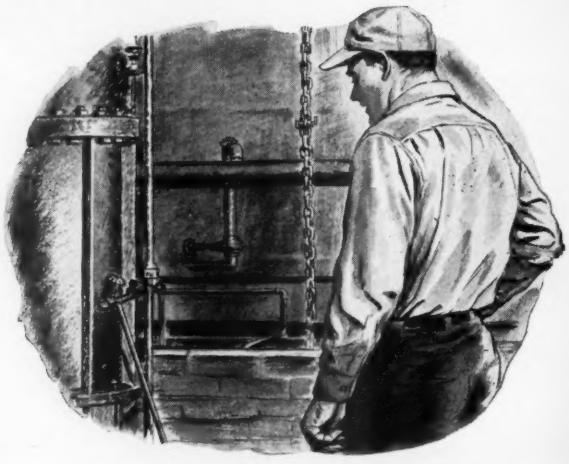
Our freshly snow-powdered mountain tops tell of fabulous skiing fast approaching. . . . Plan now to be with us at Killington, Pico, Bromley, Sugarbush, Okemo, High Pond, to name but a few of the ski areas close to the many hotels and ski lodges in and near Rutland, our home town. . . . So many choices of where-to-go and where-to-stay – so much skiing variety. . . . May we tell you more – send folders, maps, rates? Just say "yes" on your letterhead – no obligation, of course.

• *This advertisement is published in the interest of Vermont – a good place to live, work and play – by CARRIS REELS, INC. of Rutland, specialists in non-returnable reels and spools for the wire industry.*

new, cost-reducing chemical for ACID PICKLING BATHS

AMCHEM SERSEAL* reduces heating requirements up to 70%, improves working conditions!

BEFORE SERSEAL, steam vapors and fumes escape from the bath, making working conditions unpleasant, lowering morale.



SERSEAL HAS BLANKETED THE BATH in just 10 seconds. All steam, corrosive fumes and vapors are contained within bath.

Put these 7 important Serseal advantages to work for you!...

1 Save up to 70% in heating costs.

2 Improve working conditions both from a comfort and health standpoint. Steam, heat, fumes and vapors are contained within the bath.

3 Cut warmup time. The blanket prevents heat loss.

4 Less corrosion of surrounding equipment. Corrosive fumes are retained in the bath.

5 Reduce the cost for heating elements.

6 Less exhaust equipment required. Since the bath is sealed, there is little escape of fumes and vapors. And in many cases, ventilating systems can be safely eliminated.

7 Now proving its economy, efficiency and overall satisfaction in many customer plants.

Write today for complete information about this important new cost-reducing, work-saving chemical blanket for acid pickling baths! Address Ambler 31, Pa.

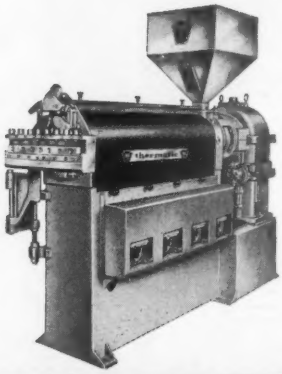
AMCHEM

*Patent applied for **SERSEAL**

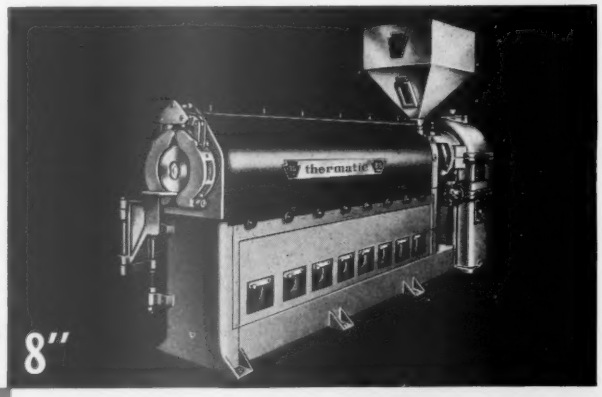
Amchem Serseal is another chemical development of **Amchem Products, Inc.** (Formerly American Chemical Paint Co.) AMBLER 31, PA. • Detroit, Mich. • St. Joseph, Mo. • Niles, Calif. • Windsor, Ont. • Amchem is a registered trademark of Amchem Products, Inc.

SIZE for SIZE

A New thermatic Series* extruder will outproduce any extruder on the market



4½"



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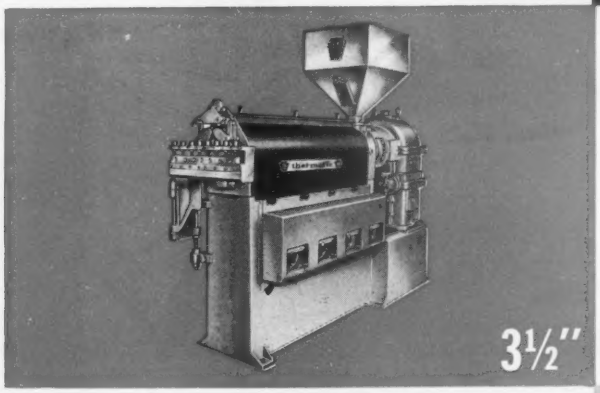

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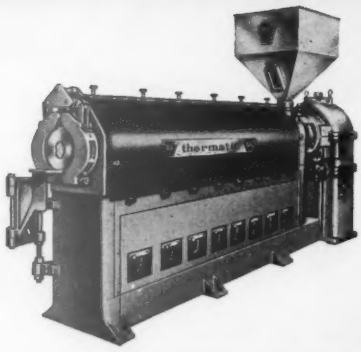

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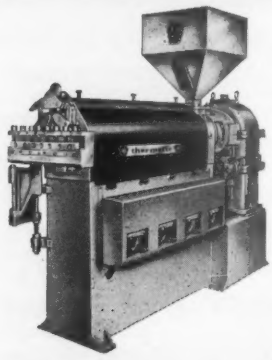

2½"

	2½"	3½"	4½"	6"	8"
More Horsepower Capacity	64	107	142	209	308
Higher Screw Speeds	200	150	110	85	60
Greater Output (lbs./hr.)*	200	375	600	900	1500

*PE (20,000 mol. wt., 4.0 melt index, 0.92 sp. gr., 500°F., 3000 p.s.i)

*Patented

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Wherever wire and wire rope handling problems are discussed — at high level conferences or on production lines — men mention Apco Mossberg in the same breath with steel reels, spools and bobbins. And for good reasons.

Reasons such as Apco's staff of engineers. These are men long experienced in the ways of efficient wire drawing, reeling and spooling. Men with proven ability to come up with practical solutions . . . answers which often pay off in substantial production and shipping economies. Then, too, there are the men behind the men . . . skilled craftsmen working with modern, high speed production facilities to bring you custom engineered units in any size or design.

Together these wire-wise men can make short work of your toughest handling problem. Try them and see at your earliest opportunity.

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October 12-15

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Lamb Street, Attleboro, Mass.

You'll get a better product with

Pittsburgh PX-120 DIDP

Pittsburgh PX-120 (DiIso Decyl Phthalate) offers you a unique combination of properties which make it especially suitable for the economical production of vinyl-jacketed electrical wiring.

PX-120 possesses excellent low-volatility, a prime consideration in vinyl wire insulation, especially where higher-than-normal temperatures are encountered. For additional retention of elongation on aging, Pittsburgh PX-120 can be supplied with Bisphenol A added.

Whatever your vinyl product, you can count on PX-120 for good permanence, resistance to extraction, and low temperature properties . . . plus a low specific gravity that enables you to enjoy appreciable economies on a pound-volume production basis.

May we acquaint you further with this versatile plasticizer? Write for samples and technical data.

PITTSBURGH *Job-Rated* PLASTICIZERS

PX-104 DiButyl Phthalate	PX-208 DiIsoOctyl Adipate
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PX-114 Decyl Butyl Phthalate	PX-218 IsoOctyl Decyl Adipate
PX-914 Butyl Octyl Phthalate	PX-220 DiIso Decyl Adipate
PX-118 IsoOctyl Decyl Phthalate	PX-238 DiOctyl Adipate
PX-120 DiIso Decyl Phthalate	PX-404 DiButyl Sebacate
PX-126 DiTri Decyl Phthalate	PX-438 DiOctyl Sebacate
PX-138 DiOctyl Phthalate	PX-800 Epoxy
PX-314 n-Octyl, n-Decyl Phthalate	PX-917 TriCresyl Phosphate

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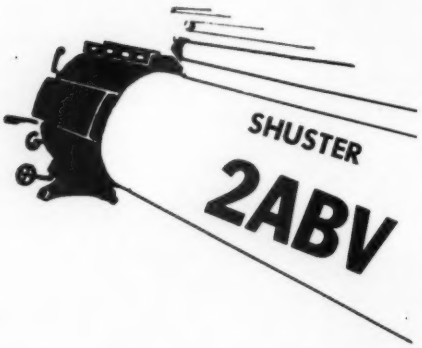
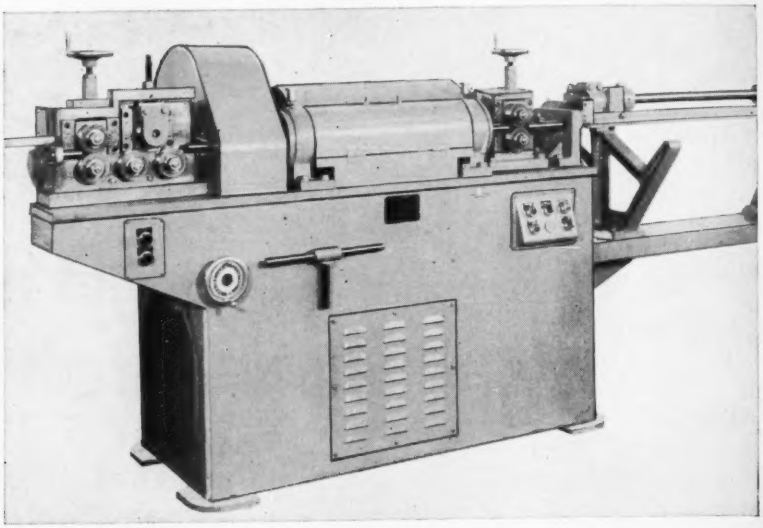
NOVEMBER 2-6, 1959

PLAN TO VISIT THE SHUSTER EXHIBIT AT BOOTH *1712*





Capacity: 5/32" To 3/8"
Round or 1/4" Square
or 1/4" Spring Wire

The BEST is *STANDARD* with SHUSTER!

The SHUSTER 2ABV Wire Straightening and Cutting Machine as illustrated, includes many new features as Standard Equipment. These features are your key to fast, accurate, and economical production.

Infinite variable speeds 50 to 200 F.P.M., electrically controlled tripping mechanism, electric brake on clutch shaft, positive release target, improved guide bar, Timken and ball bearing equipped.

In addition to the features listed above, the 2ABV has a 5 roll gear driven preliminary straightening unit. This device removes the natural curve of the wire before it enters the rotary flier.

This SHUSTER may be supplied with interchangeable roll straightener for use on shape stock up to or equivalent to 1/4" square. Maximum width 1/2".

There are more SHUSTERS being built and in use throughout the world than all other machines of its type.

Send us your wire straightening requirements from .020" to 11/16" for quotation.
Let us prove to you that a SHUSTER pays for itself faster than any other comparable machine.

METTLER MACHINE TOOL, INC.

155 West Adeline Street, New Haven, Conn.

LARIBEE WIRE & EQUIPMENT CORP.

CAMDEN, NEW YORK

FABRICATORS OF BARE & TINNED COPPER WIRE

- SOLIDS
- BUNCHED WIRE
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- BRAID
- SHIELDING WIRE

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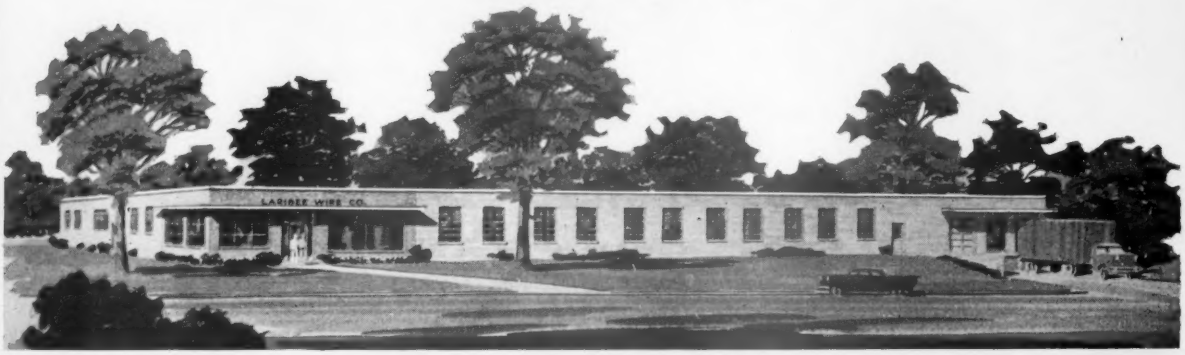
WE WANT TO SERVE YOU.



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BUNCHERS AND CONCENTRIC STRANDERS
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Camden, New York

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THE BEELINE WIRE D

A BEELINE Wire Drawing Machine will be shown in operation at the National Metal Exposition in Chicago, November 2 thru 6. Booth #1542.

E DRAWING MACHINE

WORLD WIDE

PRECISION WITH RUGGEDNESS

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U.S. OFFICE **MH. MACHINES**
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CLEVELAND 22, OHIO
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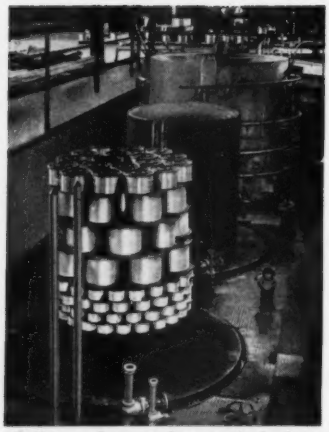
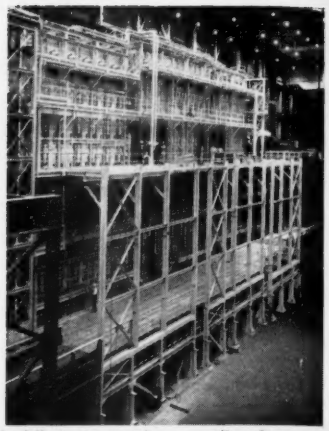


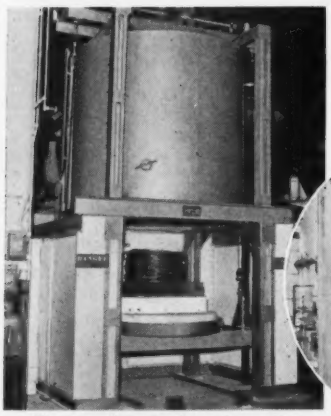
Bell type furnace for spooled wire.

Sunbeam WIRE and STRIP FURNACES

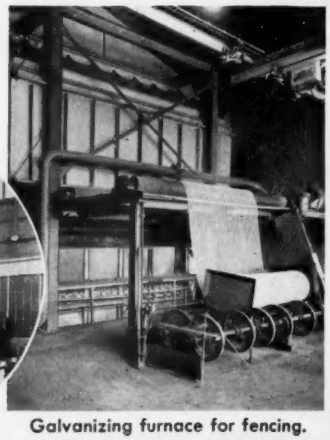
Bell type furnace for wire or strip.



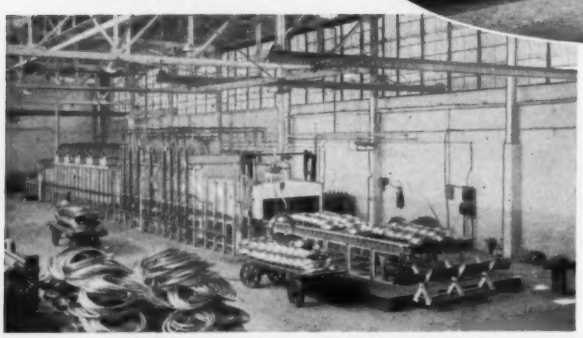
World's largest strip annealing furnace.



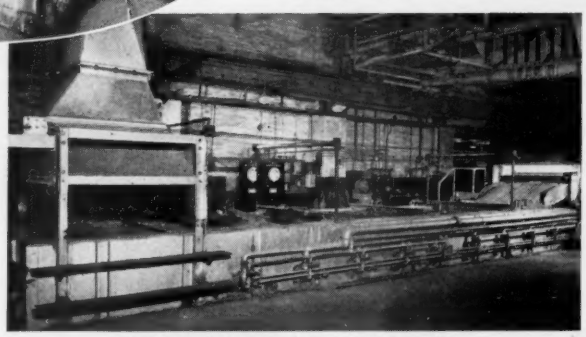
Elevator furnace for wire coils.



Galvanizing furnace for fencing.



Roller hearth furnace for wire coils.



Lead bath furnace for wire in strands.

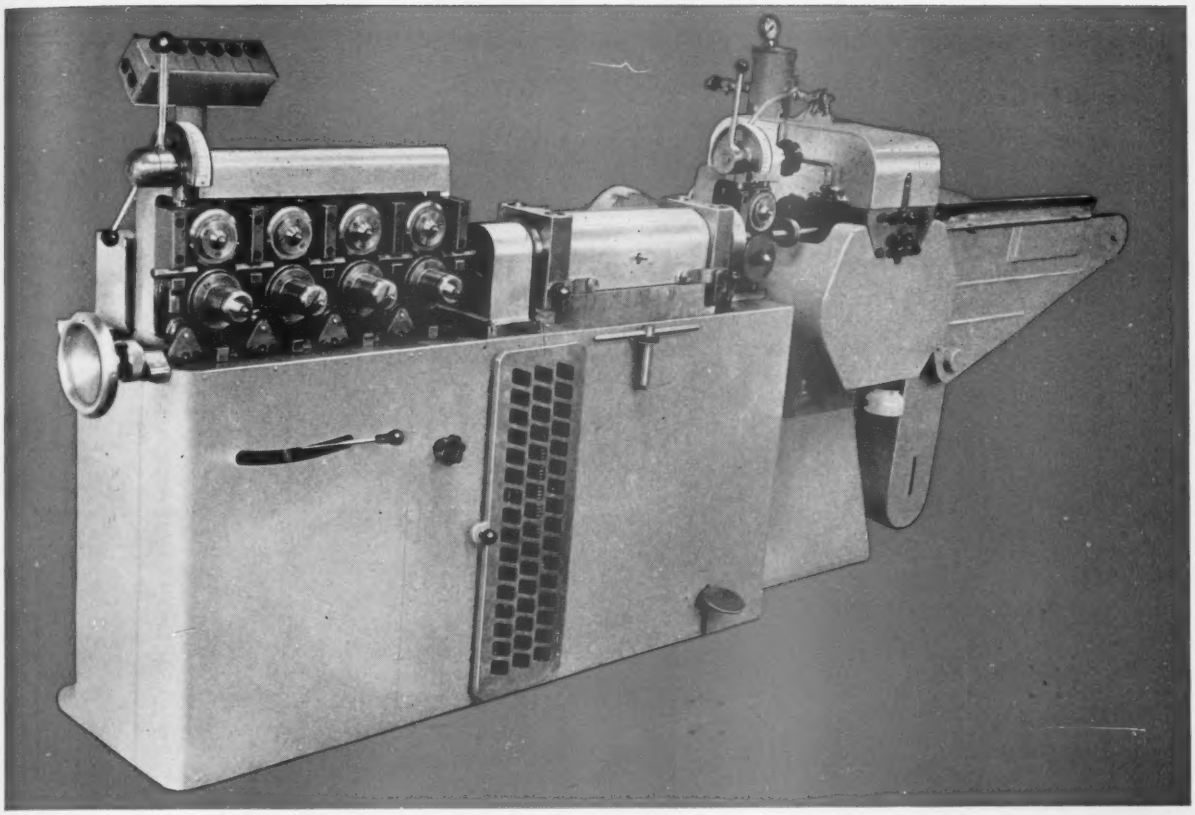
Complete service available . . . design through installation

Sunbeam equipment for the metals industry includes complete wire and strip furnace installations . . . batch or continuous—for ferrous and non-ferrous metals. We build the largest, the smallest and everything in between. All auxiliary equipment for heat treatment including cleaning, cooling, fluxing, coating, atmosphere generation, process and control panel, and handling equipment can be furnished as a single contract. In this manner you obtain the many added advantages of dealing with a single supplier—in purchasing, planning, delivery, installation and service. Whether planning an expansion, opening a new plant or replacing equipment, it will pay you to see Sunbeam first. Let us know your requirements.

Sunbeam
THE BEST INDUSTRIAL FURNACES MADE

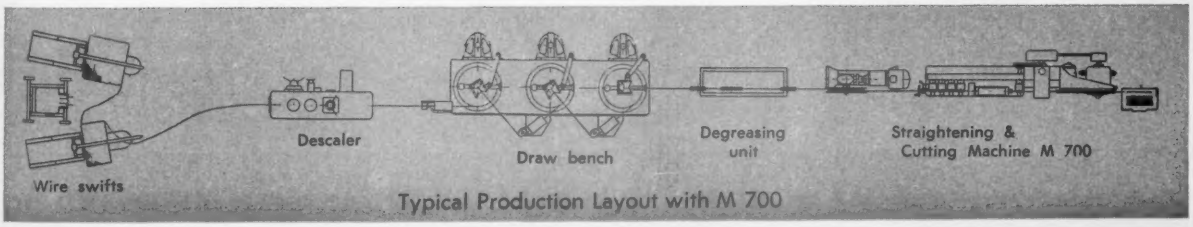
Sunbeam EQUIPMENT CORPORATION

Dept. 252 198 Mercer St. Meadville, Penna.



725 absolutely straight and burr-free rods

for example, 8 s.w.g. wire can be cut into 18" lengths at 725 cuts/min. with the M 700.



Typical Production Layout with M 700

Visit us at the Metal Show in Chicago, Nov. 2-5, and see the M 700 in action.

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Gothenburg
Sweden

NEW ENGLAND HIGH CARBON WIRE CO.

THE STEEL COMPANY OF CANADA, LIMITED

Union Wire Rope Corporation

CONTINENTAL STEEL CORPORATION

REYNOLDS WIRE

The GILBERT & BENNETT MFG. CO.

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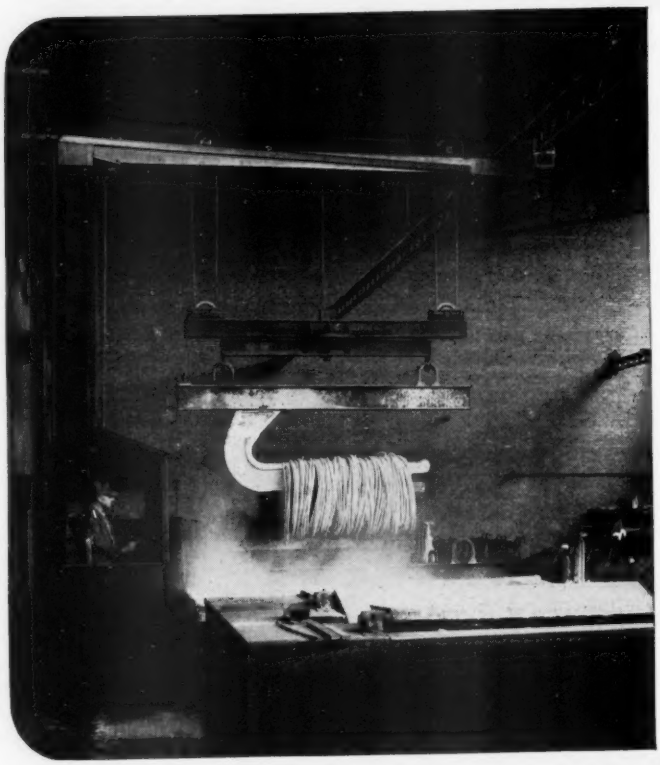
Important Names in the



THE NATIONAL SCREW & MANUFACTURING CO.

Thompson Wire Company

CF&I-WICKWIRE WIRE

MID-STATES STEEL & WIRE CO.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO.

WYMAN-GORDON COMPANY

SHEFFIELD STEEL CORPORATION

CRUCIBLE STEEL COMPANY OF AMERICA

THE CLEVELAND CAP SCREW CO.

REPUBLIC STEEL

ROEBLING

Wire and Rod Industry

MOST companies in the wire and rod industry have swung over to the straight-line method of cleaning originated and developed by Cleveland Tramrail. Those represented here have one or more Cleveland Tramrail installations cleaning 75 to 950 tons per day.

When equipped with a Cleveland Tramrail gantry crane and arranged for straight-line production, a cleaning house is far more efficient. More wire or rod is cleaned faster at lower cost in the same floor area. Working conditions are healthier, cleaner, more orderly. A modern Cleveland Tramrail-equipped cleaning house soon pays for itself out of savings it makes possible.

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Overhead Materials Handling Equipment

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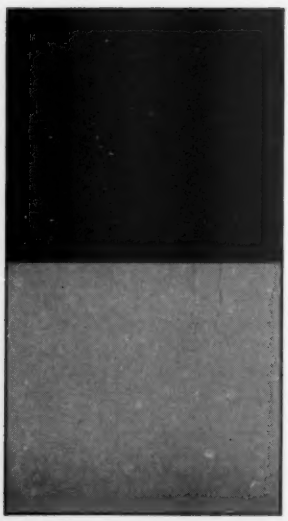
NATIONAL-STANDARD

WASHBURN WIRE COMPANY

Reid-Avery Company, Inc.

POOLED ENGINEERING PRODUCES NEW WIRE STRIPPING AND COILING MACHINE



The Problem Development of a high speed close tolerance method for producing nylon coated wire circuit breaker coils with pre-stripped ends for soldering. **The Attack** A cooperative program by the Rush Wire Stripper Division of The Eraser Company and Torrington Wire Forming engineers. **The Solution** Combining an intermittent stripper, the new Rush Model 2086 Wire Stripping Machine, and the Torrington W-3000 Torsion Winder. **The Technique** An electric stripping machine is placed between the payoff reel and the Torsion winder. As the winding head begins the recoil stroke, a signal from a cam-operated limit switch on the Torsion winder actuates the stripping mechanism. The machine is timed to strip only that portion of the wire which will appear on the ends of the finished coil. (If a 3/16″ strip is needed on each end, the machine strips 3/8″ at a time.)

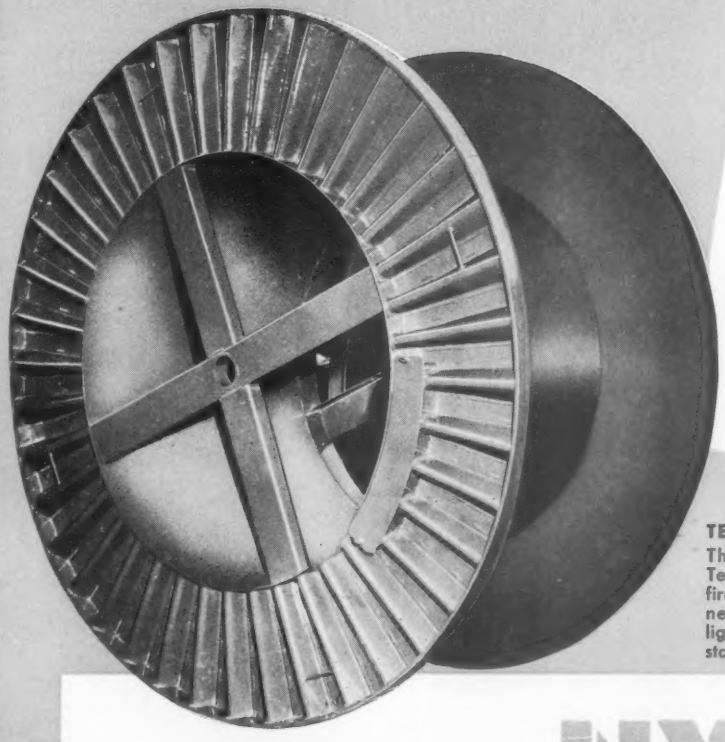
The stripper consists essentially of a stripping head, a clamping device and a traveling table assembly. In the stripping head are mounted four knives which revolve about the wire at high speed and turn down the insulation to the depth desired. The clamping device holds the wire stationary while the table assembly carries the knives back along the wire line. The knives open automatically when the required length of wire has been stripped. The machine follows this sequence of operations: 1. Winding head begins recoil stroke. Wire is stationary. 2. Limit switch sends signal back to stripper. 3. Wire is clamped just forward of the stripping head. 4. Rotating knives bite into insulation. 5. Table assembly moves away from clamp. After required distance knives open. 6. Table assembly returns to original position, ready for next cycle.

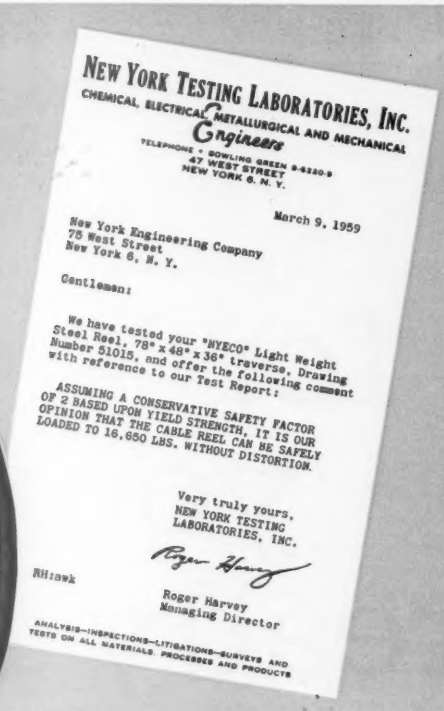
Depending upon the length to be stripped, the machine can process upward of 60 circuit breaker coils a minute.

THE TORRINGTON MANUFACTURING COMPANY

TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

Proven By Actual Test!





NEW YORK TESTING LABORATORIES, INC.
CHEMICAL, ELECTRICAL, METALLURGICAL AND MECHANICAL Engineers
TELEPHONE • BOWLING GREEN 9-4320-9
47 WEST STREET
NEW YORK 6, N. Y.

March 9, 1959

New York Engineering Company
75 West Street
New York 6, N. Y.

Gentlemen:

We have tested your "NYECO" Light Weight Steel Reel, 78" x 48" x 36" traverse, Drawing Number 51015, and offer the following comment with reference to our Test Report:

ASSUMING A CONSERVATIVE SAFETY FACTOR OF 2 BASED UPON YIELD STRENGTH, IT IS OUR OPINION THAT THE CABLE REEL CAN BE SAFELY LOADED TO 16,650 LBS. WITHOUT DISTORTION.

Very truly yours,
NEW YORK TESTING LABORATORIES, INC.
Roger Harvey

RHiawk

Roger Harvey
Managing Director

ANALYSIS—INSPECTIONS—LITIGATIONS—SURVEYS AND TESTS ON ALL MATERIALS, PROCESSES AND PRODUCTS

TESTED AND APPROVED!
This letter from New York Testing Laboratories, Inc. confirms the superiority of the new NYECO smooth-faced, light weight steel reel over standard reels.

ANNOUNCING THE NEW NYECO SMOOTH-FACED LIGHT WEIGHT STEEL REEL

NOW AVAILABLE FROM NYECO . . .

greater protection against damage in shipping and processing with this rugged, weather-resistant, warp-proof, NYECO Steel Shipping Reel. All reels are furnished with four cross-arms unless otherwise specified. Drive-holes optional. No die charges or extras . . . any drum diameters or traverse. Flange diameters 42" to 90" inclusive.

NYECO ALSO MANUFACTURES

- Impregnating Tanks
- Vulcanizers
- Floor Rolls
- Pressure Vessels

YOUR INQUIRIES WILL RECEIVE OUR PROMPT ATTENTION

Send specifications for STEEL SHIPPING REELS, IMPREGNATING REELS, PROCESSING REELS, SUBMARINE CABLE REELS AND BRIDGE REELS. Prompt deliveries on large or small orders.

ANY QUANTITY—ANY SIZE—
ANY LOAD FLANGE DIAMETER
from 42" up

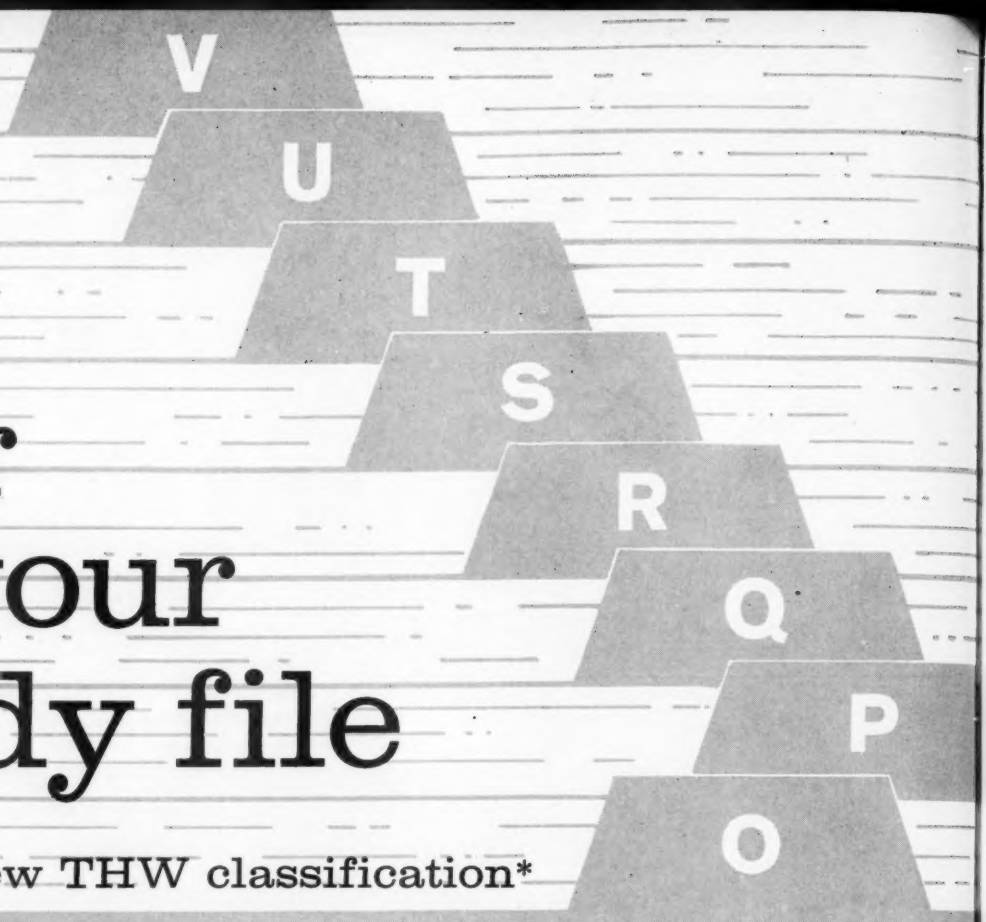
Specialists to the wire industries for over 50 years.

NYECO

NEW YORK ENGINEERING COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

TELEPHONE: WHitehall 4-5380 • CABLE: NYECO, N. Y. • PLANTS: YONKERS, N. Y.



for your ready file

To meet new THW classification*

Monsanto OPALON 71345 vinyl compound

PHYSICAL PROPERTIES	UL SPECIFICATIONS FOR THW	TYPICAL TEST VALUES FOR OPALON 71345 (#14 AWG solid wire with 3/64" insulation)
1) Tensile Strength, psi	2000 min.	2550
% Retention (aged 7 days @ 113°C)	75 min.	105
2) Elongation, % Retention	150 min.	295
(aged 7 days @ 113°C)	75 min.	91
3) Deformation, T_2/T_1 (1 hr. @ 121°C, 500 gm. wt)	0.70	0.88
4) Vertical Flame Test	Pass	Passes
5) Heat Shock Test, 121°C.	Pass	Passes
6) Mechanical Water Absorption mg/in^2	20 max.	10-13

ELECTRICAL PROPERTIES	UL SPECIFICATIONS	OPALON 7134
1) Specific Inductive Capacitance		
1000 cycles at 75°C.	10 max.	7.4
1 day	5 max.	2.3
% change 7-14 days	10 max.	7.2
2) Insulation Resistance megohms/1000 ft.		
1 day at 15.6°C.	150 min.	4200
1 day at 75°C.	0.1 min.	6.1
1 week at 75°C.		4.8
10 weeks at 75°C.		5.5
28 weeks at 75°C.		5.6
3) Conductor Corrosion	None	None
4) Dielectric Strength, volts	3000	over
1 day at 15,6°C.		20,000

(1959 edition of the National Electrical Code of the National Fire Protection Association)

*Under the new THW classification, up to 20% more current can be run through conductors than could be with TW conductors. Smaller conductors can be used, saving conduit space, cutting wiring costs. Maximum operating temperatures raised from 60° to 75° C. Good electrical properties, moisture and heat resistance, aging characteristics, economical performance, processability and freedom from conductor corrosion, make Opalon 71345 ideally suited for THW usage. For complete technical and processing data on Opalon 71345 write to Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

OPALON: REG. U. S. PAT. OFF.

Monsanto

An Apple A Day Keeps The Doctor Away

PROPERLY ENGINEERED **HEANIUM**® GUIDES DO THE SAME THING TO KEEP DAMAGE AWAY FROM YOUR YARNS.

HEANIUM® THE ORIGINAL INDUSTRIAL CERAMIC OF GEM HARDNESS WILL TAKE THE ABUSE OF TODAYS NEWEST AND MOST ABRASIVE YARNS.

THERE IS NO BETTER INSURANCE AGAINST DAMAGE THAN **HEANIUM**®.

Use Heanium®

GIVE US THE OPPORTUNITY TO SERVE YOU

WE THRIVE ON PROBLEMS

HEANY INDUSTRIAL CERAMIC CORP.

P. O. BOX 530 NEW HAVEN 3, CONNECTICUT

LET'S TALK WIRE!

These lock washers are typical of many types and sizes of lock washers made from PAGE wire—and lock washers are just one of the many end products for which PAGE manufacturers wire is a logical choice.

Regardless of your use of wire, you can count on PAGE uniformity. Whether you make hairpins or lock washers, PAGE wire will give you the tensile strength, ductility, finish, tolerance and other properties you require.

PAGE facilities are designed to produce a wide range of high quality manufacturers wire items—including special shapes. Where requirements are exacting, you will find PAGE wire unexcelled.

Since 1902, we have pioneered many "firsts" in the wire industry. The latest of these is corrosion-resistant ACCO *Aluminized* Wire—commercially pure aluminum bonded to a steel core.

Why not put PAGE experience and knowledge to work for you to improve your product and lower your costs.

ACCO

PAGE MANUFACTURERS WIRE

Page Steel and Wire Division • American Chain & Cable Company, Inc.

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

PAGE *-the source for answers to wire problems*

Greetings . . . . . ALL MEMBERS
AND GUESTS OF **THE WIRE ASSOCIATION**

WE ARE PROUD OF THE COMPANY(S) WE KEEP (*happy that is...*)

KENNECOTT WIRE AND CABLE
UNITED STATES STEEL
MID-STATES STEEL AND WIRE
KAISER ALUMINUM
BELDEN MANUFACTURING COMPANY
BRIDGEPORT BRASS
CONTINENTAL STEEL
INTERNATIONAL NICKEL
BRODERICK AND BASCOM ROPE COMPANY
STEEL COMPANY OF CANADA
SIMPLEX WIRE AND CABLE
LACLEDE STEEL
BETHLEHEM STEEL
B. GREENING WIRE COMPANY
JONES & LAUGHLIN
NEHRING ELECTRICAL WORKS
B. F. GOODRICH COMPANY
COPPERWELD STEEL
AMERICAN CHAIN AND CABLE

. . . AND MANY OTHERS

Our roster of distinguished users of Micro-Welders reads like the Blue Book of American Industry.

Ask THE FIRMS WHO USE MICRO-WELDERS

. . . for continuous butt welding of ferrous wire, sizes .005″ to 1.250″

. . . for continuous butt welding of non-ferrous wire, sizes .010″ through 1.000″. . .

They will tell you that Micro-Welders are

- **Easy to Operate**
- **Durable**
- **Economical**

MICROMETER PRECISION — MICRO-WELD — TRADE MARK REGISTERED

OUR 30 YEARS OF EXPERIENCE IN THIS HIGHLY SPECIALIZED FIELD ARE AT YOUR COMMAND . . .

MICRO PRODUCTS CO.

MODEL S.E.M.T.
For Welding All Types of Fine Wire Aluminum, Copper, Brass, Bronze, Steel and Steel Alloys, sizes .005″ to .020″

Model S. E. M. T. is equipped with a temperature-indicating device for annealing and tempering, voltage regulator and meter to compensate for voltage fluctuations, wire cutters, extra large magnifying glass, fluorescent light and extension cord. Can be supplied for bench-mounting or mounted on 4-wheel truck.

Model A. C. M. T., similar in design, covers capacities from .010″ to .062″.

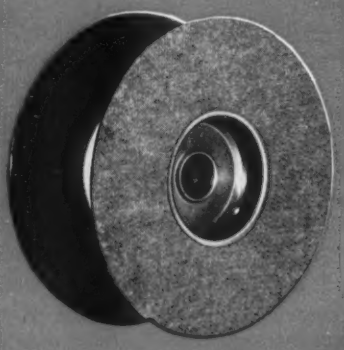
20 NO. WACKER DRIVE
CHICAGO 6, ILLINOIS
TELEPHONE STate 2-7468

HUBBARD HAS IT

If it's a spool or reel,
HUBBARD makes it.

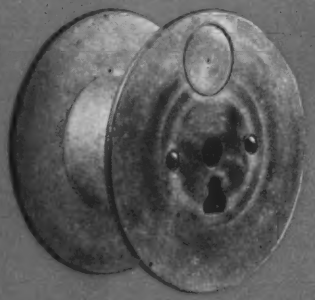
EVERY TYPE:
Wood - Steel - Plywood
Masonite - Cardboard
Aluminum

HUBBARD is headquarters for any reel or spool requirement.



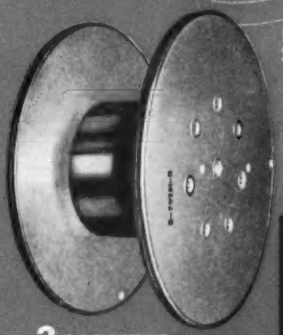
Reel with a masonite flange and cardboard hub assembled with steel end washers for domestic and export shipment of wire, tape, braid or other materials.

Heavy Duty Precision Brazed Steel Spool for drawing and processing of wire. Strongly and accurately made for long service.

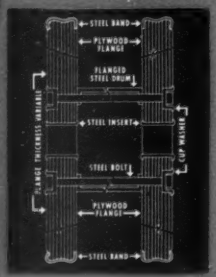


Non-Returnable Magnet Wire Shipping Reels designed for High-speed wire take-off. Light in weight, low in cost, high in impact and tensile strength. Ideal for palletized shipments.

PLYWOOD MARRIES **STEEL**

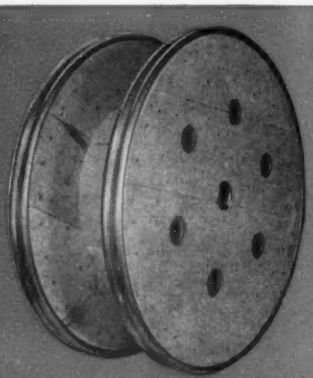


FOR BETTER SHOP REELS
RESULTING IN
1 GREATER IMPACT STRENGTH
2 LOWER MAINTENANCE COSTS

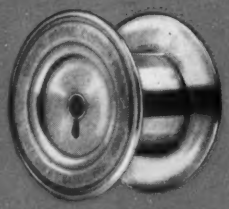


3 LIGHTER WEIGHT FOR EASIER HANDLING
4 ABILITY TO WITHSTAND SUBMERGENCE IN WATER
5 WIDE RANGE OF SIZES

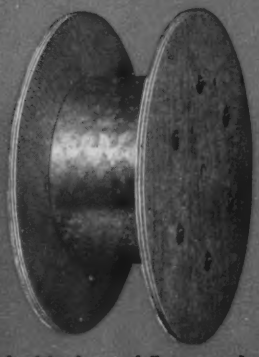
HUBBARD SPOOLS & REELS are made in a modern plant with every facility for the manufacture of standard and special types of highest quality at the lowest possible cost.



Top quality wood reels armored with cadmium steel for maximum strength and long service.



Aluminum Reels designed for customers' appeal. Heads are strong. All welded construction. Smooth surfaces. Tare weight uniform. Ideal for bulk shipping.



Reel with plywood flange and galvanized steel hub assembled with tubular rivets and special washers for heavier loads.

HUBBARD SPOOL DIVISION
TELEPHONE: GARRETT 840 *The American Pulley Company* GARRETT, INDIANA

The Wire Outlook

In spite of the cloud of uncertainty for business created by the striking steel workers, which ultimately must be settled so that inflation will be checked by curbing the ever-upward spiral of wages, a fine attendance is indicated. It has been well said that we must bring inflation to a halt soon or before long the only exports left will be American jobs instead of American products. That labor, both by insisting upon wage increases and by limiting the work a man can do, is pricing our products out of even domestic markets is too well recognized to require comment here.

It is only fair to say, however, that the tactics of labor's leaders is not the only factor tending to force inflation. Government spending and high taxation contribute to this unfortunate situation. The majority of our solons are more political opportunists than statesmen, more concerned with their personal fortunes than with the welfare of the country. They are the ones who should be setting the pace in economy and wisdom. Practically every effort on the part of the Administration to curb waste and unneeded spending has been squelched by these so-called representatives of the people.

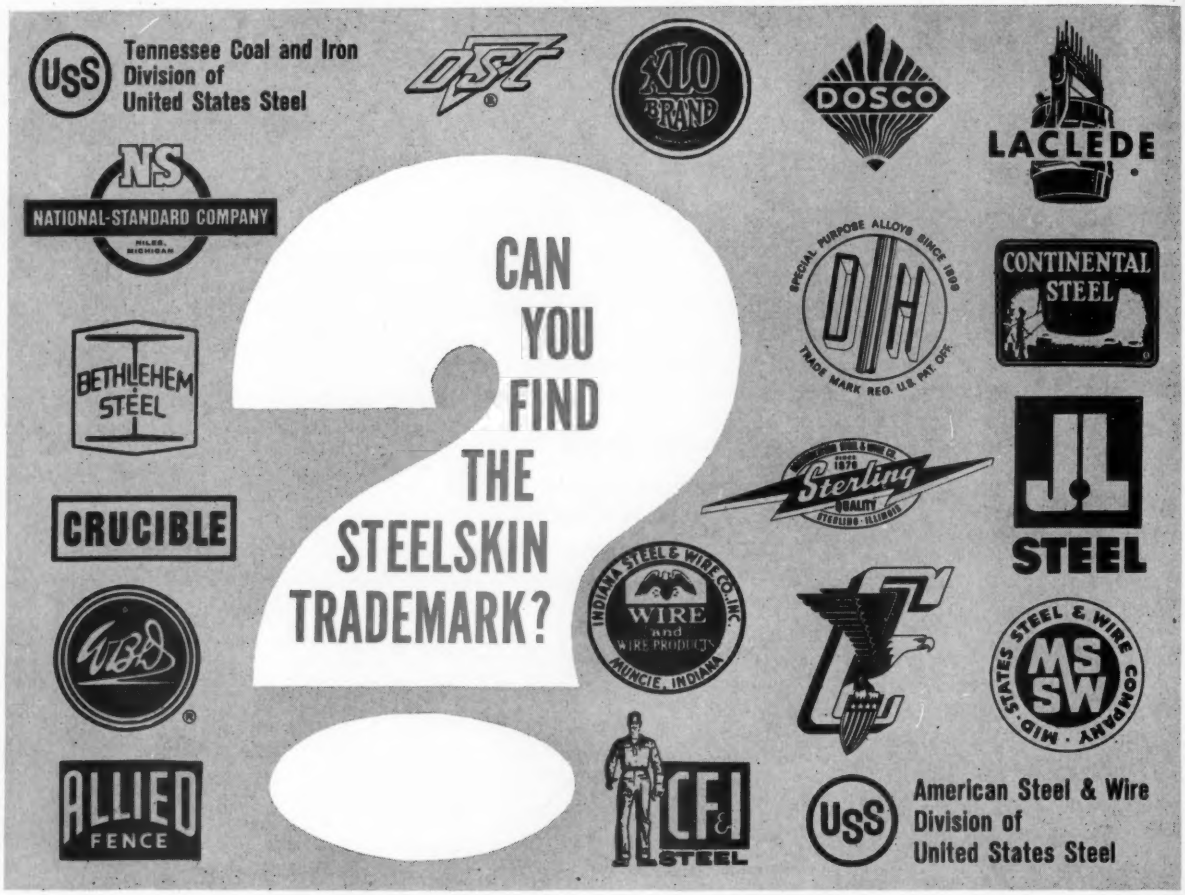
Business to this point has been good, employment stands at a record high and it is forecast that when labor gets back to work, there will be a period of unequalled activity, albeit when the flow of materials again gets under way, it may be some months before rail and trucking facilities can cope with all of the demands upon them to move manufactured products.

Gross national product was up in July 12½ per cent over the 1958 low, advancing to a rate of $484.5 billion. Heavy construction contracts rose by $411.7 million, raising the total to $13.2 billion for the year, and while private building rose a bit in August, the totals are $15 million under a year ago—$197 million.

Wire mills that are operating are shipping their products as fast as they can turn them out, some of the strongest items being manufacturers' wire, highway mesh and products for construction. Fastener makers are doing well and those producing wire for the automotive industry find business good. Wire supplies should hold out until October 1, but after that, unless steel's blast furnaces can be fired, foreign sources of wire may be the independents' chief dependence.

While at this writing no settlement is in sight, it is to be hoped that basic differences soon will be composed.

Edmund Duval Sickels
EDITOR



It's part of every well known insignia on this page . . . an invisible, but all important part of the production of the myriads of products these companies produce. Every one a top brand . . . and every one of these well known manufacturers use STEELSKIN for wire drawing lubricants and compounds.

These are companies with whom we've worked closely ...companies who know they can depend on us, because in our 50 years of experience we have specialized in the development and production of superior wire drawing compounds.

If **you** draw wire, if you'd like to solve a wire drawing problem, we can be of service to **you.**

Incidentally, stop and see us in Suite 743-745 at the Statler-Hilton during the Wire Association Convention.

R. H. MILLER 50th ANNIVERSARY Steelskin Lubricants

Steelskin® TRADE MARK

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

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The Drawing and Handling of Long Production Run Wire Coils

by Uno V. Johnson, Superintendent
Portsmouth Division Rod and Wire Mills
Detroit Steel Corporation
Portsmouth, Ohio

Detroit Steel Corporation's Portsmouth Division Rod and Wire Mill produces high and low carbon hot rolled rods in sizes from 7/32″ (.218″ to 9/16″ (.562″). The rod coil has an inside diameter of 34″ and weighs approximately 320 pounds. From such rod bundles we produce high and low carbon dry-drawn round wire in sizes from .023″ to .500″, and in single length coils weighing from 150 pounds to over 4,000 pounds each.

* * *

When we think about the venerable art of wire drawing, it seems odd that as recently as the early '50's wire production was generally limited to coils weighing not much in excess of about 300 pounds, otherwise defined as the product of a single rod bundle. Obviously no pressing demand had yet been encountered in the trade for bigger, weightier single length wire coils. If such a demand existed at all it was a deep, dark secret, at least so far as Detroit Steel was concerned.

* * *

The first serious thought we gave to the possibilities of bigger, weightier coils was during 1951. By then we had been operating our battery of 16 Vaughn continuous drawing machines about three years. These had been installed in 1948 when we established our original incentive rates based on using 320 pound rod bundles. These bundles were butt-welded on the flipper boom ahead of the drawing machine, then the weld was cut out on the finishing block and the wire was stripped in 300 pound coils. The wire drawer, after stripping, tied the coil with three banding wires and placed it on a buggy for delivery to the testing department or to other processing departments.

Uno V. Johnson

Mr. Johnson has been in the wire business for over forty-two years starting with Spencer Wire Company in Worcester, Massachusetts, which later became Wickwire-Spencer Steel Corporation. Later he was transferred to their Buffalo Works where he was promoted to Superintendent of the Wire Mill and the Welded Fabric Department in 1941.

Since 1947 he has been Superintendent of the Detroit Steel Corporation's Portsmouth Division Rod and Wire Mill.

He presented this paper at the Annual Convention of The Wire Association on October 13, 1959, in Cleveland, Ohio.

* * *

We had been studying the operation for several months, seeking opportunities for cost reduction. In 1952, therefore, when drawing high carbon wire in the manner described a moment ago, we started stripping the wire off the blocks in 600 pound coils instead of 300 pound coils. As expected, our wire drawing costs showed an encouraging reduction.

* * *

Later the same year, we tried drawing high carbon wire in 1,200 pound continuous length coils for use in our wire patenting operations. By this change of method we improved not only our wire drawing and patenting efficiency, but we also expedited handling and reduced its cost in the patenting operation.

Here is how we accomplished this. Using four rod coils that had been welded end-to-end, we reduced them to size in a 22″ finishing block into which we inserted a solid, non-collapsible stripper. The 1,200 pound coils thus generated were removed from the finishing block and dispatched to the wire patenting unit on the stripper. That enabled the wire patenting furnace reeler to place the wire on a revolving pay-off stand. That way, handling and splicing were accomplished in one operation instead of four per 1,200 pounds of wire. The change from 300-pound to 1,200-pound bundles made it possible to reduce the wire patenting crew from three operators to two. The date of that development was March 9, 1953. Our experiences in drawing 1,200-pound coils on this equipment were later applied to spring wire produced for shipment in coils. The wire was delivered to the bundling room on strippers, then split and strapped on automatic strapping machines for shipment in coils, in weights ranging from 150 pounds to 600 pounds depending upon the requirements of individual customers.

* * *

By the end of March, 1953, we had accumulated sufficient experience in drawing these bigger, weightier spring wire coils to justify our confidence in the practicality and economy of producing them. We therefore invited selected spring wire fabricators to visit our mill so that they could see the procedures we had perfected up to that time, and so judge the applicability of these big coils to their own requirements. They expressed their interest by placing large enough orders to run conclusive tests under their own operating conditions. We supplied the initial lots in coils averaging 1,310 pounds each, and we also provided the necessary reels for the trial. In every case the customer reported receipt of the wire in perfect condition. Their trials confirmed the time- and cost-saving potential of the big coils in fabrication and material handling, as well as in scrap-loss reduction.

* * *

One of these spring fabricators, who in fact was and is one of the largest in the industry, expressed great interest in adopting the new type coil for their full requirements. They informed us that they had called in representatives from two major wire producers and demonstrated the performance of our coils to them for the purpose of inducing them to supply similar packages. However these mills would not commit themselves to this innovation, a decision which set back the further development of these big coils for three or four years.

* * *

Shortly after this experience, a representative from another wire producer visited our Rod and Wire Mill. They were interested in these 1,200-pound coils for use in manufacturing some of their own end products. They expressed great interest in our procedures and sometime thereafter they started supplying other wire fabricators with the heavier coils which they shipped on special carrier reels.

* * *

Naturally we continued producing and using the big coils in our own Portsmouth operations. By 1956 we lifted our sights in the development of this material as we proved the feasibility and economy of producing these coils in bundles weighing up to about 4,000 pounds each. In 1957 we installed a new 156″ welded wire fabric machine and also rehabilitated our other fabric manufacturing facilities. This necessitated the revamping of our wire drawing equipment for the specific purpose of expanding our production of the big coils which, by then, were being referred to as "long production run coils."

* * *

Here are some of the changes we made in our facilities to accommodate the big coils:

—We raised and reinforced the crane runways to handle 3,000 pound to 4,000 pound coils.

—We replaced our 1,000 pound capacity cranes with cranes capable of handling 4,000 pounds.

—We replaced 22″ and 26″ drawing blocks with 30″ blocks.

—We provided a heavy-duty collapsible stripper.

—We provided carrier reels for handling the coils after drawing.

—We modified our mill trucks to accommodate carrier reels.

—We replaced revolving pay-off reels with boom flippers, thus making possible greater efficiency in the welding of the rods and thereby improving the efficiency of the continuous wire drawing operations.

* * *

This equipment on which the wire is drawn for use in the welded fabric production consists of individual motor-driven single blocks. The heavy-weight coils are produced from 320 pound rod coils in the following manner:

* * *

A ram tractor delivers the pickled and coated rods to the wire drawing equipment, in loads consisting of thirteen coils weighing approximately 4,200 pounds. A lift tractor places the rods on a specially designed stand in front of the entrance end of a drawing machine with the ram in a horizontal position holding the rods vertically with the eye of the coils facing the drawing machine. The rod coils are then joined together by butt-welding the front end of one coil to the back end of an adjacent coil. This is done while the wire is being cold drawn into a continuous, long production run coil.

* * *

The butt-welding operation (see Figure No. 1) is performed on an automatic electric resistance welder by clamping two prepared ends of rod coils into the welding jaws. When contact is made, the welder heats the metal and applies pressure, forcing the two coil ends together to make a continuous length. The welding cycle is started and automatically completed by one down stroke of the foot pedal.

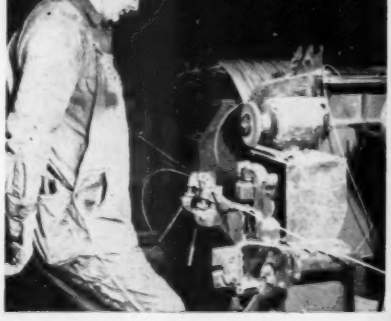


Fig. No. 1—Butt-Welding Operation

Uniform quality of the weld depends upon strict adherence to

established welding procedure. This procedure includes:

(a) The proper preparation of the ends of the rod coils.

(b) The insertion of the ends in the jaws of the machine so that they are concentrically aligned with each other.

(c) The proper setting of the machine to result in the required heat output for the welding of the different sizes and grades of steel.

* * *

The welded section is allowed to cool. The weld flash is then ground to the diameter of the original rod on a small emery wheel which is a part of the welding equipment. A desirable grain structure of the rod is then obtained in the welded section by a controlled heat treatment. This heat treatment is done at the welding machine on a unit provided for the resistance heat treating of the welded section and adjacent areas. The welding, grinding and heat treating operations are performed far enough ahead of the drawing operation to allow for the proper rate of cooling in air. This restores the original physical properties to the welded section, resulting in the required physical properties in the finished wire.

* * *

At the start of the wire drawing operation, a large collapsible stripper is inserted into the finishing block. When seven to thirteen rod coils have been welded and drawn to make a 2,000 to 4,000 pound continuous long production run wire coil, the coil is then removed from the finishing block by means of an overhead crane and the stripper (see Figure No. 2).

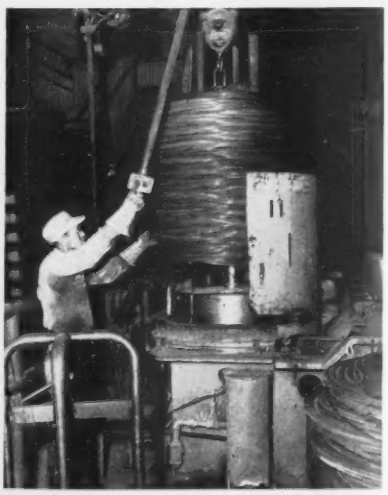


Fig. No. 2—Removal of Coil from Finishing Block

The wire is then transferred to a carrier reel for delivery to the welded fabric mill (see Figures No. 3 and No. 4).

* * *

In the welded fabric operation the old, revolving type pay-off reels used for the handling of 300 pound coils were replaced with revolving adapter bases, thus facilitating the placement of the heavy coil and the reel on the pay-off base. With the

Fig. No. 3—Transferring Coil from Collapsible Stripper to Carrier Reel

old reels and the 300 pound coils, the individual coils used to be placed on the reel and joined together by butt-welding in the welded fabric operation (see Figure No. 5).

* * *

With the long production run coil, we are now butt-welding and transferring one coil instead of ten,

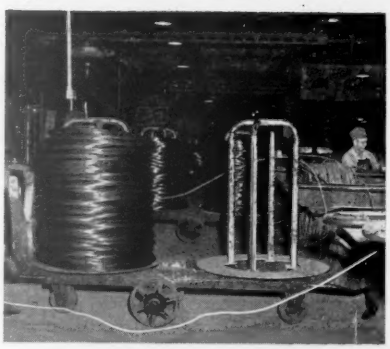


Fig. No. 4—Wire on Stripper Loaded on Buggy for Transfer to Other Departments

a saving of 90%. This change improved the fabric mill's operating efficiency by reducing overall manhour costs, cutting the scrap loss, and by better utilization of space.

* * *

As a result of the development described, our Portsmouth Division now supplies low, medium and high carbon brite wire in long production run coils. These coils weigh from 2,000 pounds to about 4,000 pounds each. They are self-supporting as strapped and require no carrier reels in transit or in storage. In low and medium carbon specifications, the sizes range from about .072″ to about .500″; in the higher carbons, from about .072″ to .250″ (see Figure No. 6).

* * *

In sizes .072" and larger, the wire is drawn on a conventional 30″ block, the same as used for drawing 300 pound coils. The 30″ block appears to be the most satisfactory from the standpoint of coil height,

(*Please turn to page* 1402)

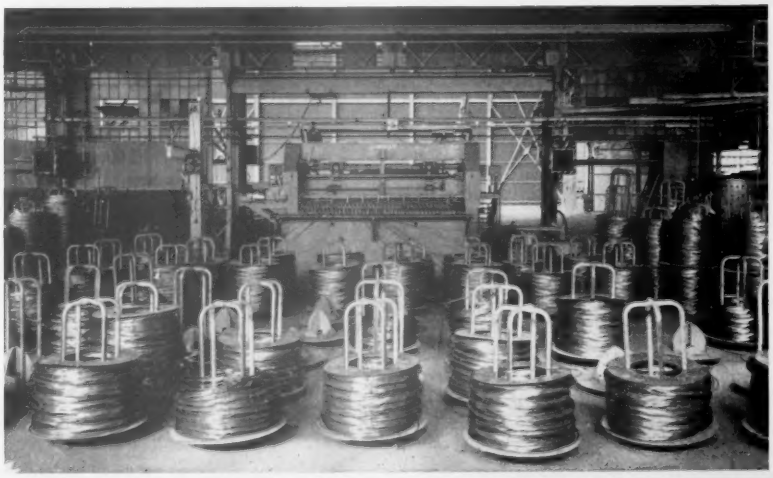
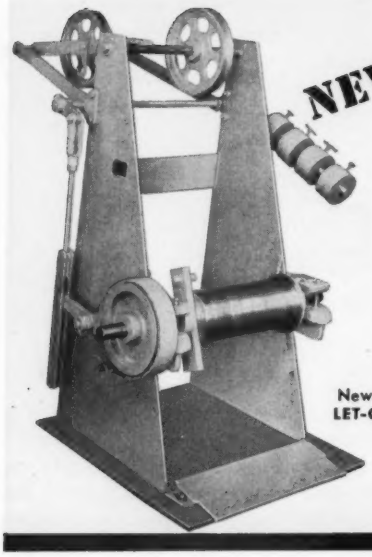


Fig. No. 5—Welded Fabric Operation



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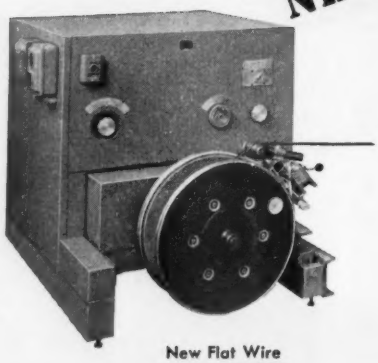

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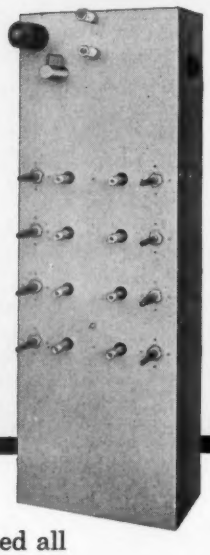

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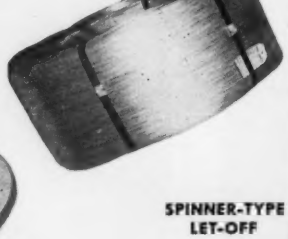
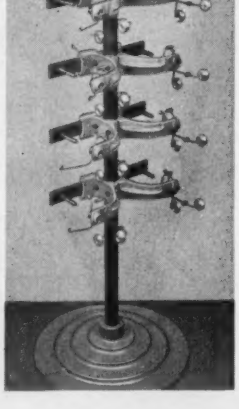


SPINNER-TYPE
LET-OFF



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Trends in Copper and Copper Alloy Rod and Wire

by Richard J. Christine
Metallurgical Manager
The American Brass Company
Torrington, Connecticut

With the advent of the Space Age and the accelerated metallurgical advances demanded by scientific developments, competitive positions are forcing processing techniques and new applications to the fore. The oldest useful metal known to man is going through another research and development stage.

* * *

When man walked out of the darkness of the Stone Age, copper metallurgy, crude as it might appear, opened the door and literally illuminated the path to our present level of civilization. Copper has and always will play the dominant role of the indispensable metal — at times it may be overshadowed, and underestimated (the Iron Age) but that is only because man is so accustomed to having copper as his genie that its presence and usefulness is taken for granted. For better or for worse, man is wedded to copper and the fruits of this union in a large measure determine his well being.

* * *

Copper is the pulse and nerve center for the heart and mind of American industry. In our rockets and contemplated space ships, exotic metals and materials are necessary; fuel elements and the orbital speed are integral functions, but it is copper and copper alloys that supply the nerve centers and make it possible to tie all the components together into a functioning unit. Consider space communications — it wouldn't do us much good to send satellites into outer space without some means of communication and data-collecting agencies. Copper certainly plays an integral part in the space communication program. A host of other specific applications in the electronics field no doubt come to mind.

Richard J. Christine

The author graduated from Yale University in 1947 with a degree of Metallurgical Engineer. He secured a Masters Degree in 1952. He is a member of Sigma XI and AIME. Mr. Christine joined the American Brass Company in 1947, where he has held various positions in the Technical Department, currently being Metallurgical Manager of the Torrington Division.

The paper was prepared for presentation on October 13, 1959, at the Annual Convention of The Wire Association in Cleveland, Ohio.

However, it is my intention to review the trends in copper and copper alloy wire and rod. Processing techniques are usually the stumbling block for transposing research developments into commercially available metal products. The evolution of a new product or technique does not necessarily follow the classic lines defined by research, pilot production, market development, and ultimately, consumer preference for a successful product. This is particularly true of copper and copper alloys, which have always appealed to the curiosity of our best scientific minds. Much information of a basic nature is already available to the research teams of the copper industry. The catalyzing agent and the motivating trend is the demand from the embryonic space age industries for commercial products to meet literally "out of this world" properties. The trend can then be summarized as a face lifting and streamlining of the old copper metallurgy; best evidenced in the new demands for wire and rod products. Research and development teams are busy expanding the useful knowledge of copper and copper alloys in an effort to define the properties most suitable for specific engineering applications.

* * *

Stability at elevated temperature combined with good electrical conductivity is probably a combination most sought after by design engineers and our industries' research teams. Two wire alloys are now commercially available, and the alloy systems are unique. Chromium copper and zirconium copper are heat treatable alloys with good stability of mechanical properties up to temperatures in the order of 600° F.

* * *

Chromium copper in the fully heat treated condition following a solution anneal will exhibit properties combining a tensile strength of about 75,000 psi with conductivity in the order of 80 to 85% IACS. Zirconium copper has somewhat better stability characteristics at elevated temperatures and conductivity in the order of 90 to 95% IACS; the strength properties developed by heat treating are, however, somewhat lower than chromium copper.

* * *

Processing these heat treatable alloys into wire and rod form present difficulties. The casting techniques are critical and must be closely controlled. The extrusion into wire or rod is complicated by the tendency to form subscale, and some overhauling is usually necessary. Solution-annealing tempera-

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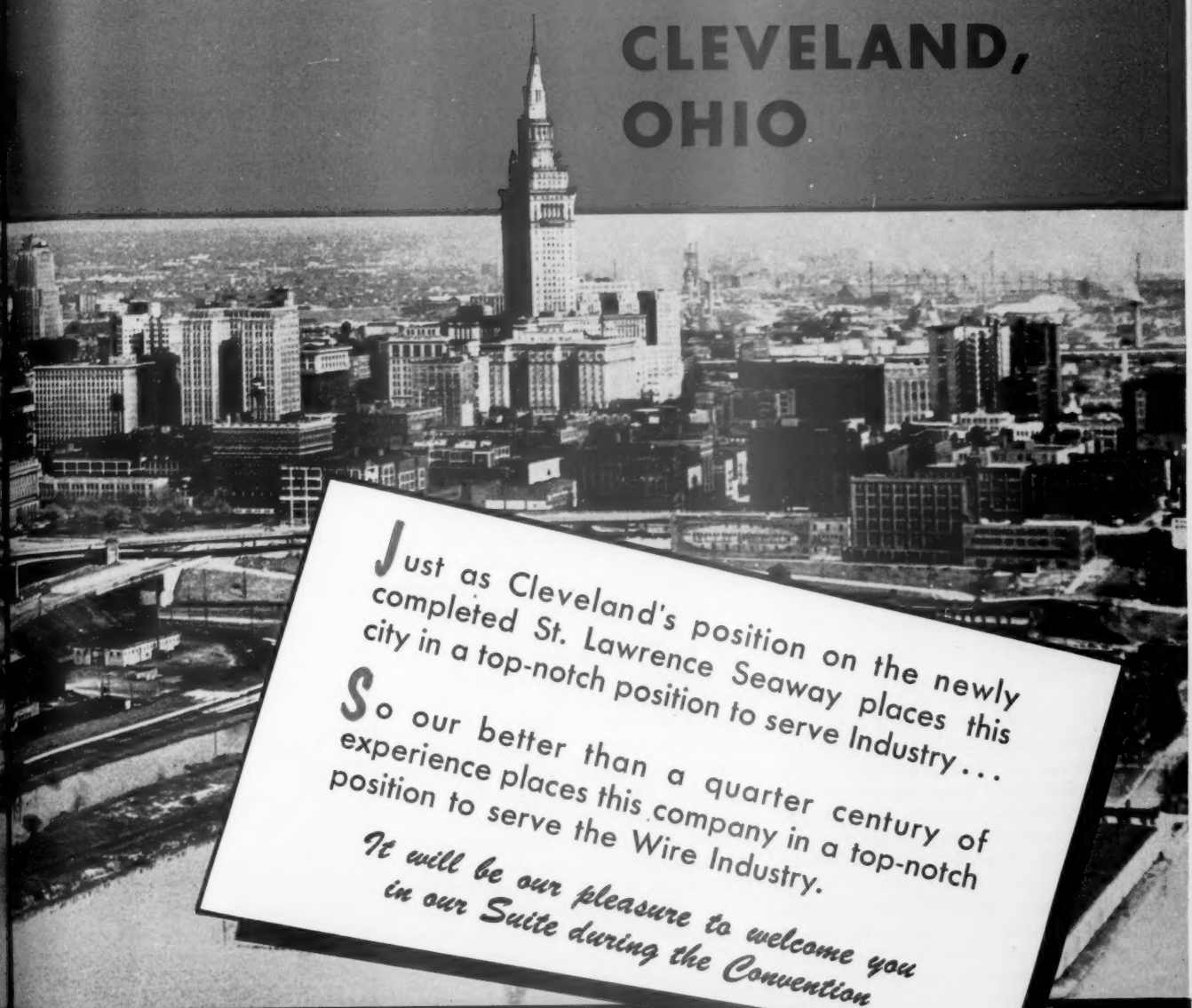

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tures are high, 900-1000°C, and a rapid quench is necessary to develop optimum properties on subsequent heat treatment. All this complicates and places a premium on furnace construction and processing sequences.

* * *

Several other heat treatable copper alloys with intermediate properties are gaining recognition in the connector and electronics fields. These alloys fall into a conductivity range of from 45 to 65% IACS, and tensile strengths in the order of 90,000 to 100,000 psi. Processing considerations similar to the chromium and zirconium coppers are encountered on these alloys in varying degrees. The most popular alloy systems are the copper-nickel - phosphorus and copper - nickel - silicon series with modifications for free machining or other specific requirements. These alloys have a solution annealing temperature about 100 to 200°C lower than the chromium and zirconium coppers.

* * *

For example, a leaded copper-nickel-phosphorus alloy is solution annealed in a roller hearth furnace with a double waterfall spray curtain acting as quench on the exit. The precipitation anneal follows in a conventional batch-type atmosphere furnace. The only complication in the processing comes from subscale.

* * *

The widespread use of panel or harness construction for linking segments of electrical control devices has made the requirement for free cutting coppers mandatory. Screw machine shops are fabricating these connector components of various designs by the millions. The Copper Industry has responded by making numerous alloys available. Currently the most popular free-cutting coppers are leaded copper with a conductivity of about 98% IACS; tellurium copper at about 95% IACS and sulfur copper at 96% IACS. Some of these free cutting coppers have residual oxygen and can become brittle or gassed under the usual conditions contributing to this phenomenon. All, however, can be obtained with a combination of deoxidizers or oxygen free copper. In the case of the deoxidized variety, some slight sacrifice in conductivity will be noticed. Usual usage very seldom requires conductivity in excess of 90% IACS — and this presents no problem for these coppers.

* * *

Although these coppers have a machinability rating of 80 on a scale where free cutting yellow brass is rated 100, this figure can be misinterpreted. The amount of residual cold work and particularly the type of screw machine and tooling are among the factors that affect the rated performance.

* * *

All of these coppers can be cold worked without too much trouble. They can be supplied in a suitable wire temper for cold heading and secondary operations designed around the basic alloy system. Up to now there has not been too much interest in these alloys for wire forming or heading operations. Close dimensional tolerances may be the reason for the reluctance of the heading people to get into this connector business. Alloys are available with the ductility and mechanical properties necessary for this type of forming. It would appear that some of the products could be made more economically by cold heading or wire forming operations.

* * *

So far I have mentioned only the newer alloy systems that have been developed primarily for electrical control devices — the electronics industry. Recent trends have also affected the old brass and copper reliables. There can't be any product more prosaic than free-cutting brass rod; it is the cheapest of such commodities and at one time was the easiest to process — all one had to do was to extrude, draw to finish dimensions, and ship out the door. With few exceptions, this practice won't work today. Deep drilling, roll threading, knurling, staking, slotting, etc., have complicated the picture, but the latest efforts of the screw machine builders have laid this ghost to rest. We now hear of beta-free rod for close tolerances on deep drilling applications. Similar grain structures, but not necessarily the same temper, are required for roll threading, knurling and staking or whenever extra ductility is needed. Along with the consideration of grain structure, it has been necessary to take advantage of the broad chemical composition range for free cutting brass. Most suppliers subdivide the standard compositional range into two parts, utilizing the lower copper range for the larger sizes that will normally be machined on the heavier, faster screw machines where chip breaking and clearing the tools are the most important considerations. This might be considered the rough, break-down type of stock.

* * *

For the smaller diameters, specialization has been the watchword. Depending upon your specific needs, you can now obtain free cutting brass rod with all alpha, fine grained structure or an alpha-beta fine grained extruded structure, or possibly a combination of both. For certain applications you might need a coarse grained, all-alpha structure. Lead dispersion and lead content are other variables that can and will be controlled to meet fabricating or end-use requirements.

* * *

In the heading industry, more advantage is being taken of the wide selection of copper and brass alloys that are available. For all practical purposes, there isn't a copper alloy system available in wire form that can't be cold headed. The nickel silvers, phosphor bronzes, and silicon bronzes combine good ductility and high strength with excellent corrosion resistance. The whole range of common brasses have specific applications and can be tailored to various heading operations.

* * *

As in the case of free cutting brass, the demands of the heading industry have up-graded wire processing requirements. Extensive studies have been made to determine the factors affecting cold flow in a header. Most of the answers have been found but die wear and concentric flow into the head have not been fully explained, or perhaps a better term would be completely controlled. At one time, seamy wire and split heads plagued

(*Please turn to page* 1405)

Quality Control in an Alloy Steel Bar Mill

by T. P. Davis
Statistical Quality Control Engineer
Allegheny Ludlum Steel Corporation
Watervliet, New York

Today it is called "Total Quality Control." Yesterday, it was "Statistical Quality Control." Before that it was "Inspection." Perhaps in the beginning someone asked "was it checked?"

* * *

So "quality control" has been evolving. Not only has its name been changing but the scope, responsibilities and activities are constantly being expanded, revised and extended into the Corporation organization. The name evolution does imply the broadening functions of such programs. When it was "checking," it was pride of workmanship with the individual. As "inspection" systems developed it was the inspector and the supervisor, then the Chief Inspector and the Superintendent. However, because quality and hence its control involves more than product inspection, the statistical quality control engineering function came into being. There was need to coordinate processing control with product control. This began to involve purchasing, methods and customer relation policy. The costs and profits were used to show need and success or failure of quality programs. With proven need for revisions, modifications, etc. of policy in such areas, the Corporation level is very much involved. When we are administering, measuring the effect, and evaluating the effectiveness of the control of quality in these broad areas involving policy, we are discussing Total Quality Control.

* * *

A number of authorities have published writings on this phase of the evolution of quality control. **A. V. Feigenbaum** has summarized the subject very well in, "The Professional Work of the Quality Control Engineer" (1). **D. H. W. Allan** includes the subject in "Statistical Quality Control: An Introduction for Management" (2).

T. P. Davis

Mr. Davis prepared this paper for presentation at the Annual Convention of The Wire Association on October 14, 1959, at Cleveland, Ohio.

Allegheny Ludlum Steel Corporation has a program of Total Quality Control. There is enthusiastic Corporation level support with authority to get things done. There is a Corporation Quality Control organization that collaborates and coordinates with that in each of the plants.

* * *

Figure 1, schematically illustrates our quality control organization at Watervliet Works and its relation to production and finance. Our Manager of Quality Control is an assistant to the Works Manager. He directs the chemical and metallurgical laboratories and inspection department. The Statistical Quality Control Engineer functions as a member of his staff. The result is a coordination of the quality control activity with production and finance. It cannot be over emphasized that there is top level support of the functioning of the organization and that mandatory communications are maintained between the various positions shown.

* * *

This is the organization that functions in the bar mill (Watervliet, N.Y.) of Allegheny Ludlum Steel Corporation. This bar mill has electric melting furnaces; blooming and finishing mills; forging equipment, and extrusion press, and cold drawing equipment; and finishing facilities. The principal products include stainless steels, valve steels, high temperature alloys, and vacuum melted steels in bar, billet and tubular form.

* * *

First and foremost of our quality control program is the distribution of routine quality reports to management. Many of these reports are compiled and issued by quality control clerks working in a department involved in the subject

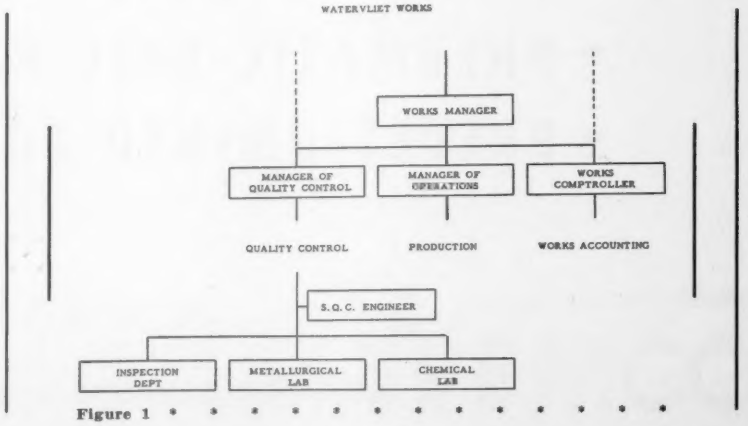


Figure 1

WEMCO

HAS IT

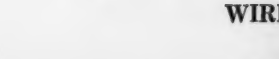
COIL-TO-REEL REWINDER

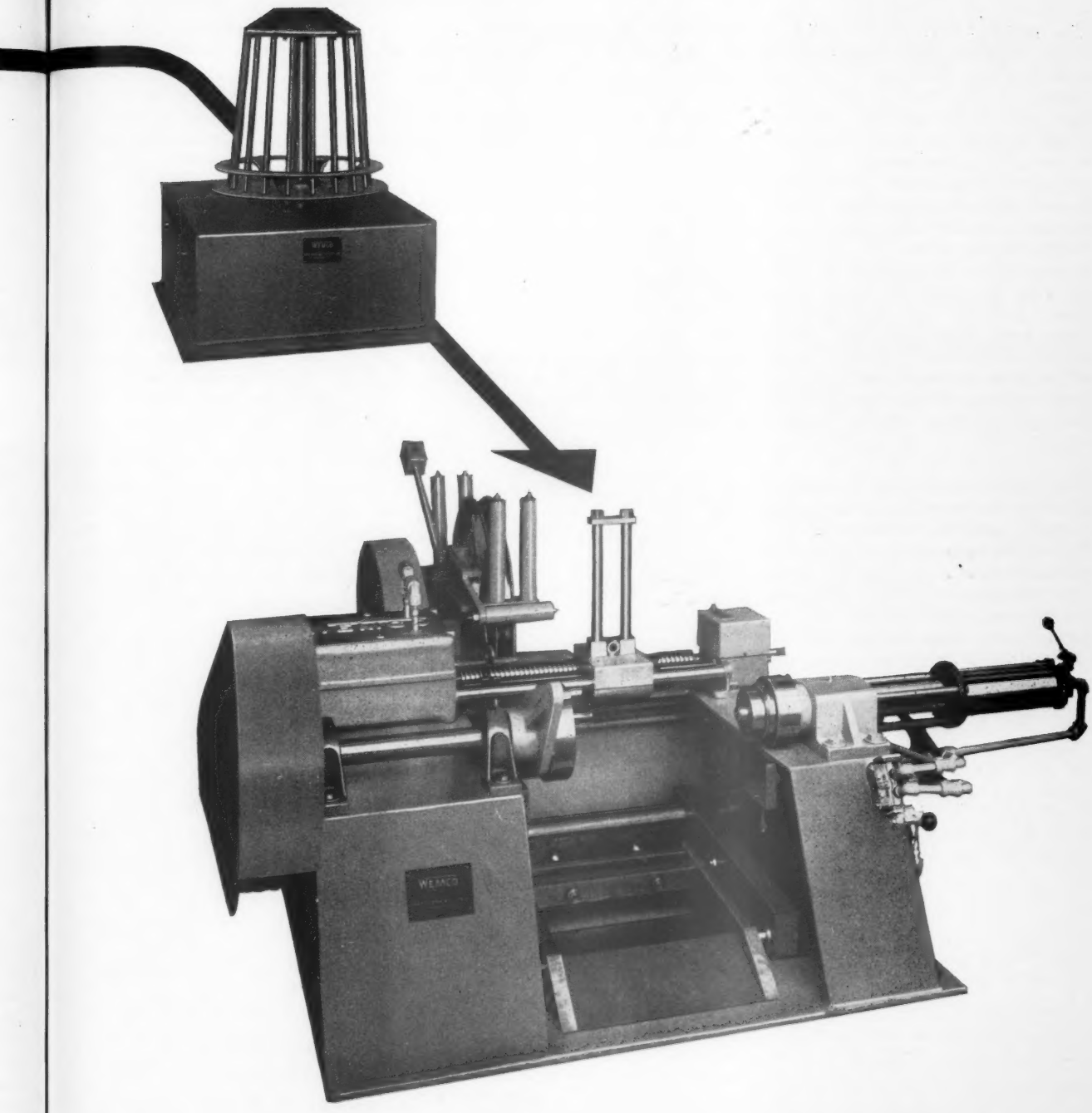
FAST, ACCURATE SPOOLING OF

- ROPE WIRE
- ACSR CORE WIRE
- ARMOUR WIRE

FROM COILS TO STRANDER BOBBINS

- PRECISION LAYERING
- CONSTANT LINEAL SPEEDS
- PNEUMATIC REEL HANDLING
- PREDETERMINED FOOTAGE

WRITE FOR COMPLETE INFORMATION 



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of a report. They are designed to define the level and consistency of quality of the various products, the control of the various processes, and plant-wide quality indexes. These reports are under constant review of the management personnel both as individuals and as members of product committees. Such reports provide Corporation and Works management with a means of evaluating the control of quality and its effect on operations. They indicate to management those areas that are under satisfactory control and highlight those where more extensive corrective action is desirable, and then report the effectiveness of the action taken.

* * *

In addition to the assurance given by the inspection, testing, and chemical analysis function of product conformance to customer specification, the metallurgical function provides standard processing instructions, and evaluates the conformance to these instructions in processing. It is the operating department's responsibility to conform and control. Naturally, it follows that in our quality control program every effort is made to put effective quality control techniques in the hands of production. To do this, it is necessary to determine the control variables, the limits within which they are to be controlled, and the applicable quality control tool, (i.e., frequency distribution, control chart, etc.) that will report the nature and degree of control achieved and be a guide to production in taking corrective action. This is usually accomplished with representatives of the metallurgical function, the production operation involved, and the Statistical Quality Control Engineer. (3) At times, these determinations are straightforward, the result of prior technical or operational knowledge. Other times, they are made only after extensive investigation which may involve statistically designed experiments or the use of analytical statistical techniques.

* * *

This procedure was recently applied to a chemical analysis problem arising in melting and will serve to illustrate the process and product control phase of our quality control program. We wanted to determine the melting variables that were materially influencing the recovery of a highly oxidizable metallic addition. This addition is made to bring the final analysis into the specified range. Wide variation in recovery had caused final analyses to be in extreme or outside the range. This was resulting in an X% of heats being unuseable. With prior technical and operational knowledge, the metallurgical, operating and Statistical Quality Control personnel arranged to punch 14 variables as recorded on the melting record into punch cards. After sufficient data had been accumulated, it was subjected to multiple regression analysis for four variables. This showed two variables had great effect, and the other two a lesser effect on the variation of the metallic addition recovery. Not only were the variables ranked in their order of influence, but there was quantitative indications of desirable limits for

(*Please turn to page* 1393)

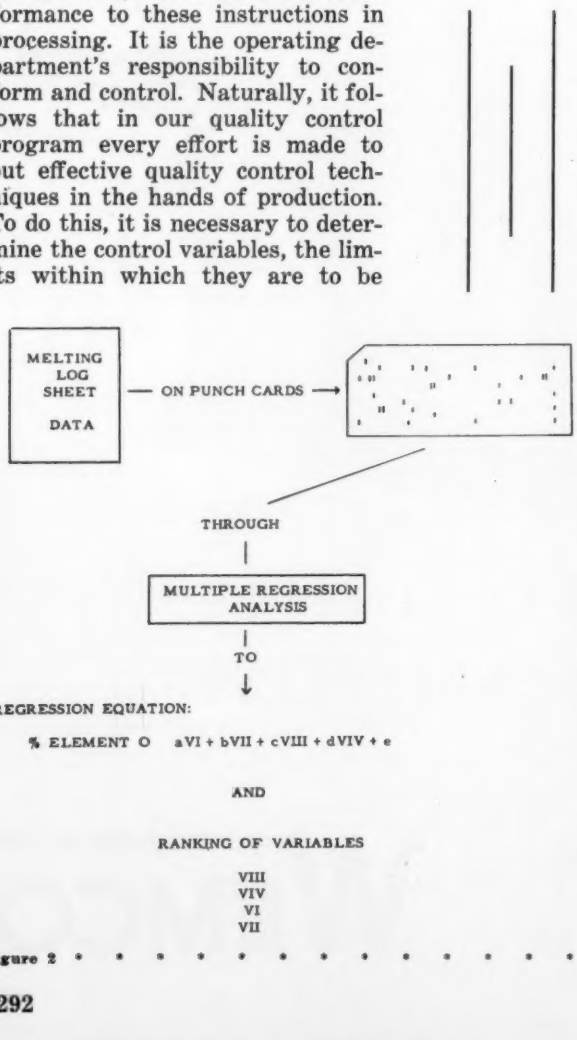


Figure 2

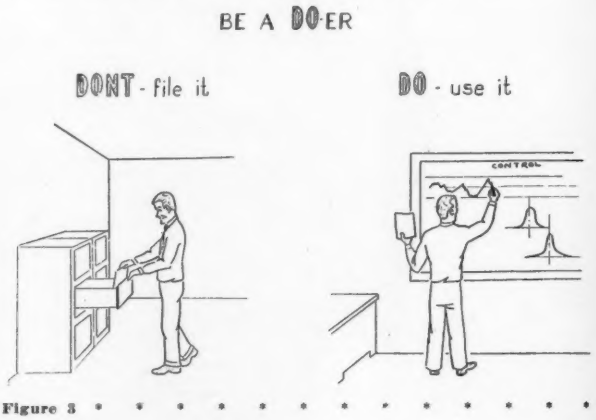


Figure 3

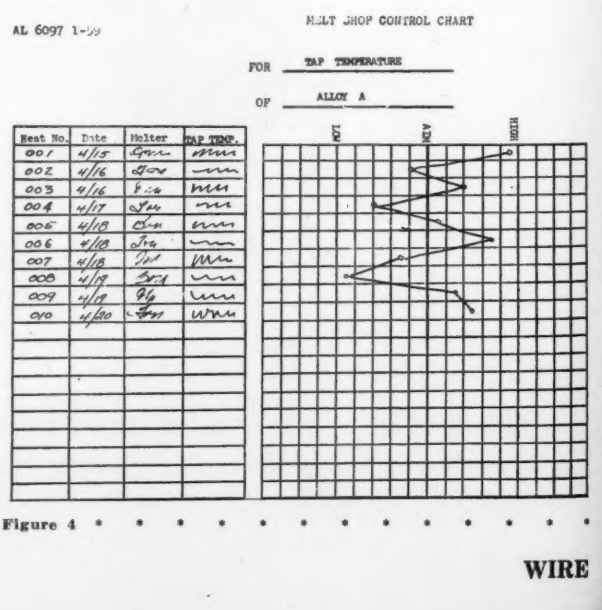


Figure 4

The Use of Irradiated Polyethylene in Wire and Cable

by Allen N. Towne
Market Development Specialist
Insulating Materials Department
General Electric Company
Schenectady, New York

Heat a polyethylene insulated cable to 160°C for a short period of time and the insulation starts to flow off. Heat a cable insulated by irradiated polyethylene to the same temperature and you have no flow. This is shown by Figure 1.

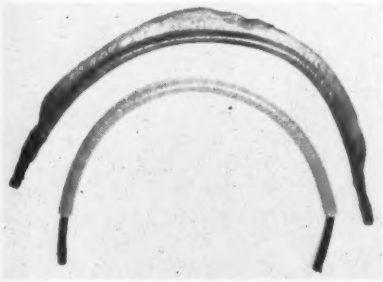


Fig. 1 — Irradiated (top) and unirradiated test cables exposed to 160°C for 6 hours.

This happens because the bombardment of polyethylene by high-energy electrons converts it from a thermoplastic to a non-melting polymer without the loss of other desirable properties.

* * *

Irradiated polyethylene is the first commercial result of extensive research in the General Electric Company on the chemical effects of high-energy radiation. Historically the development can be traced back to 1925 when **Dr. W. D. Coolidge,** inventor of the modern X-ray tube, started exploratory work on the chemical effects of high energy electrons at the Research Laboratory. Research continued until 1954 when the first commercially available irradiated polyethylene was announced.

* * *

The process basically consists of bombarding polyethylene with a beam of high-energy electrons having one-million volts peak energy. The electron beam is produced by a resonant transformer electron generator. This generator is similar to the G. E. million-volt X-ray machine except that the tungsten target has been replaced by a thin metallic window which allows the electron beam to escape into the air. The process is continuous and rapid.

* * *

The exact mechanism to account for the cross-linking in polyethylene is still a matter for speculation. The net result is that hydrogen atoms are knocked off the polymer chain leaving active sites which combine to form cross-ties and eventually a three-dimensional network. The displaced hydrogen is evolved as a gas.

* * *

Allen N. Towne

Mr. Towne is a graduate of Northeastern University. He joined General Electric Company in 1947 as a test engineer and later was made a process engineer and then a product engineer in the company's Wire and Insulation Section at Lynn, Mass. In 1955 he was transferred to the Advanced Engineering Section of the Medium Induction Motor Department in Schenectady and somewhat later assigned to his present work. This paper was prepared for presentation at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

The original polyethylene, a low density type, melts at 100-115°C., whereas the cross-linked network will not melt at all. The amount of cross-linking is related to the amount of irradiation which the material receives. Properties such as rigidity, toughness, resistance to chemicals, et cetera are functions of the amount of cross-linking. The process must be carefully controlled to obtain the optimum combination of these properties.

Characteristics of Irradiated Polyethylene

In 1951, Messrs. DelMar and Merrill of the Phelps Dodge Corporation, in a paper presented before the AIEE (1), discussed the characteristics of ordinary polyethylene. They pointed out some of the advantages of its use in other types of wire and cable.

* * *

Among the several outstanding qualities which make polyethylene an important factor in the insulation field are:

High dielectric strength
Low power factor
Low dielectric constant
Low water absorption and transmission
Good mechanical properties and flexibility
Chemical inertness
Low loss factor at all frequencies
Excellent insulation resistance
Resistance to fungi

Irradiation with high energy electrons gives a product which not only retains all of these advantages, but provides the following additional benefits:

Resistance to thermal overloads
Non-melting character
Elimination of tendency to stress crack
Stable electrical properties over a wide temperature range

High resistance to surface arcing
Ability to shrink and bond to itself

Electron irradiated polyethylene does not contain any residual radioactivity and can be handled safely.

Properties of Irradiated Polyethylene

The general properties irradiated polyethylene are shown in Table 1.

Table 1

General Properties

Specific gravity	0.92
Water absorption	<0.1%
Thermal Conductivity	8.0×10^{-4} cal/sec/cm^2/°C/cm
Chemical Resistance	Excellent resistance to alkalies, to acids except nitric, and to most other common water soluble chemicals.
Stress cracking resistance	No failures after a year in glacial acetic acid or Igepal at room temperature, or in over 2000 hours at 75°C.
Solvent Resistance	Good in most all solvents below 60°C. Above 60°C, swollen by hydrocarbons, halogenated hydrocarbons, and aromatic solvents.
Shelf life	Excellent
Outdoor weathering	Should be protected from sunlight.
Thermal stability	Must be protected against oxidation.

* * *

Irradiated polyethylene, like other polyethylenes, is chemically inert at ordinary temperatures. As the temperature is raised it, like other hydrocarbons, is subject to oxidative attack. By the use of selected chemical additives called anti-oxidants, it is possible to prolong the onset of oxidation of the polymer. Thus the stabilized irradiated polyethylene grades have a continuous operating temperature well above conventional polyethlene.

* * *

Although recommended for Class A temperature operation, under certain conditions, it is possible to use stabilized irradiated polyethylene under higher temperatures. When irradiated polyethylene is in direct contact with metals and exposed to air, the operating temperature should not exceed 105°C. When protected from air or where direct air-metal contact is absent, the operating temperature can be as high as 125°C. In the complete absence of air, for example, where overwraps, sheaths, varnishes, or sealants are used, irradiated polyethylene can be used to 200°C for long periods. In addition, short overloads where the temperature may rise to 250°C can be tolerated. Because of the many variables involved, it is not possible to state a definite maximum operating temperature. It is important for the user to determine the operating limits of each application in which irradiated polyethylene is used.

* * *

The electrical properties of irradiated polyethylene are summarized in Table 2.

Table 2

Electrical Properties

A. C. Dielectric strength (25°C, on 5 mil section)	
Short time (S/T)	2500 VPM
Step by step (S/S)	1800 VPM
Power factor (60 cycles to 10,000 mc)	0.0005
Dielectric constant (60 cycles to 10,000 mc)	2.3
Volume resistivity	greater than 10^{15} ohm-cm

Figure 2 shows the variation in A.C. dielectric strength with temperature.

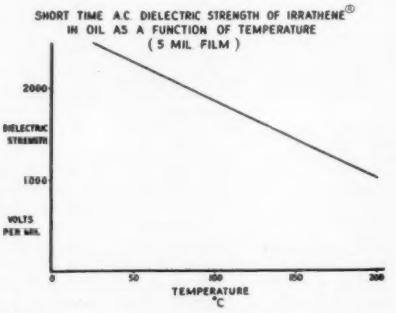


Figure 2 * * * * * * * *

Certain electrical properties depend on the construction and method of application, as well as on the inherent nature of the material itself. These properties include the corona resistance, corona starting voltage, voltage endurance, and power factor of the system. By the correct techniques in use and application, it is possible to obtain high corona starting voltages, and long voltage endurance with irradiated polyethylene. The ability of the oriented irradiated polyethylenes to shrink and bond to itself is an important property in obtaining good results.

* * *

The mechanical properties of the irradiated polyethylene insulating films depend on several factors. These include the type and grade of resin used, the conditions of extrusion used in making the film, the orientation or drawing of the film, and the degree of irradiation. This dependence of mechanical properties on several variables and stages of manufacture results in wide tolerances on such properties. It is important that rigid specifications be placed on the compounder, on the film manufacturer, and on the radiation process. In this way, a product is obtained which meets the demands for a strong, tough film. Table 3 shows typical mechanical properties of general purpose irradiated polyethylene film and of an oriented irradiated polyethylene film.

Table 3

Property		General Purpose Grade	Oriented Grade
Gauge		0.005"	0.004"
Yield Strength*	23°C	1350-1750 psi	over 2000 psi
	80°C	450-600 psi	over 500 psi
	120°C	--	--
Tensile Strength*	23°C	1900-2500 psi	over 3000 psi
	80°C	750-900 psi	over 1200 psi
	120°C	100-200 psi	over 150 psi
Elongation*	23°C	300-500%	over 200%
	80°C	300-500%	over 200%
	120°C	200-600%	over 200%
*Tests run per ASTM standard D682-54T			
Shrinkage at 150°C (lengthwise)		less than 25%	40-50%

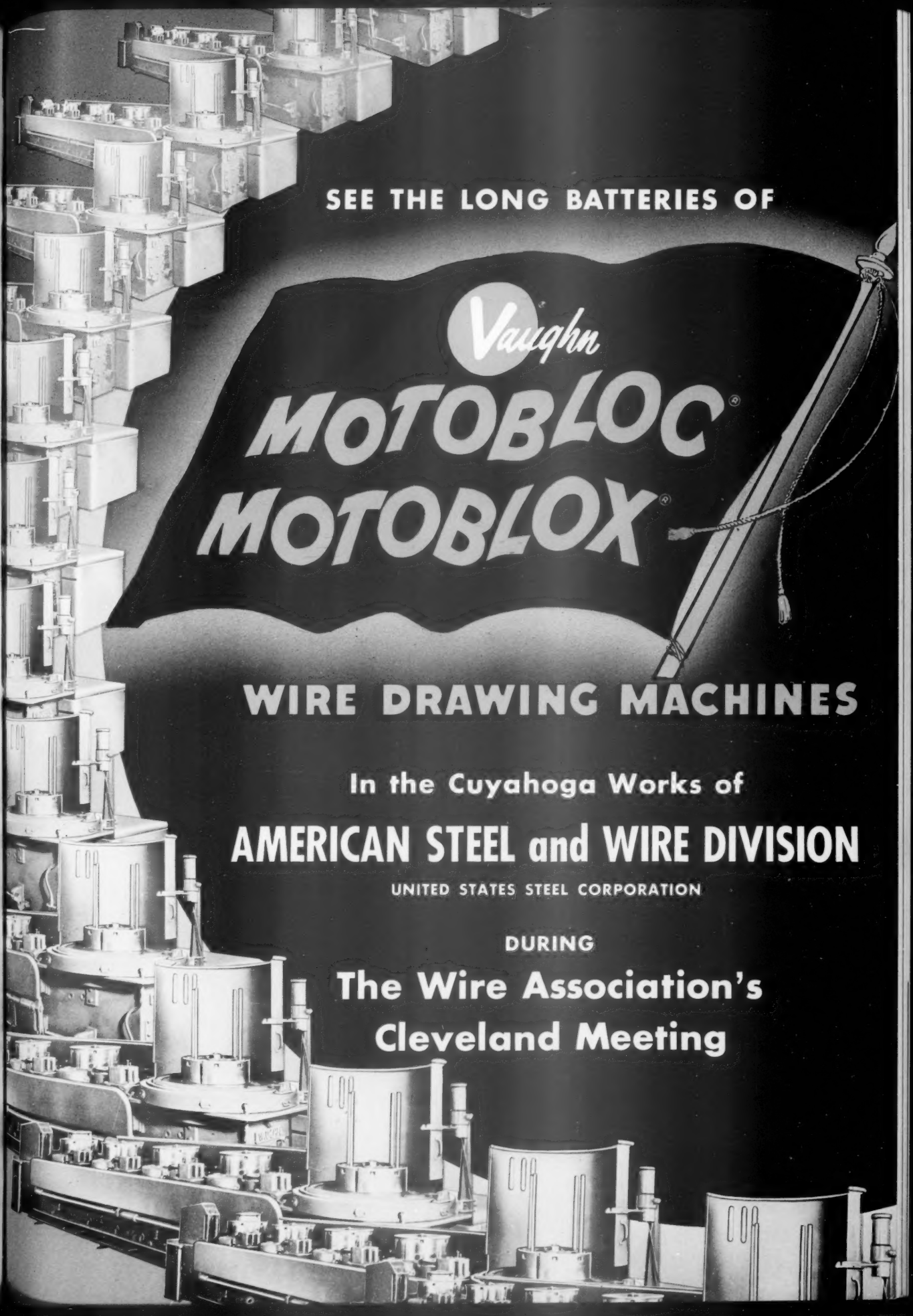
The added strength and the greater shrinkage of the oriented grades are evident in the above table. The greater strength permits the use of more tension in automatic taping equipment and therefore gives a tighter and neater wrap.

* * *

The increased shrinkage is important for those applications where encapsulation is desirable. By wrapping an object with the oriented film and heating it to about 110°C, the film will shrink about the object. Further heating to 135-150°C causes bonding between the layers of the wrap. This results in a tight impervious sheath around the object. The wrap is waterproof, dust, and chemical proof. This ability to encapsulate and seal has found considerable use in the electronics field and for certain types of cable.

* * *

The decrease in strength of irradiated polyethylene as the temperature increases is evident in Table 3. This decrease is accompanied by a change in the nature of the stress-strain relationship of the material as illustrated in Figure 3. At room temperature, irradiated polyethylene is a tough semi-rigid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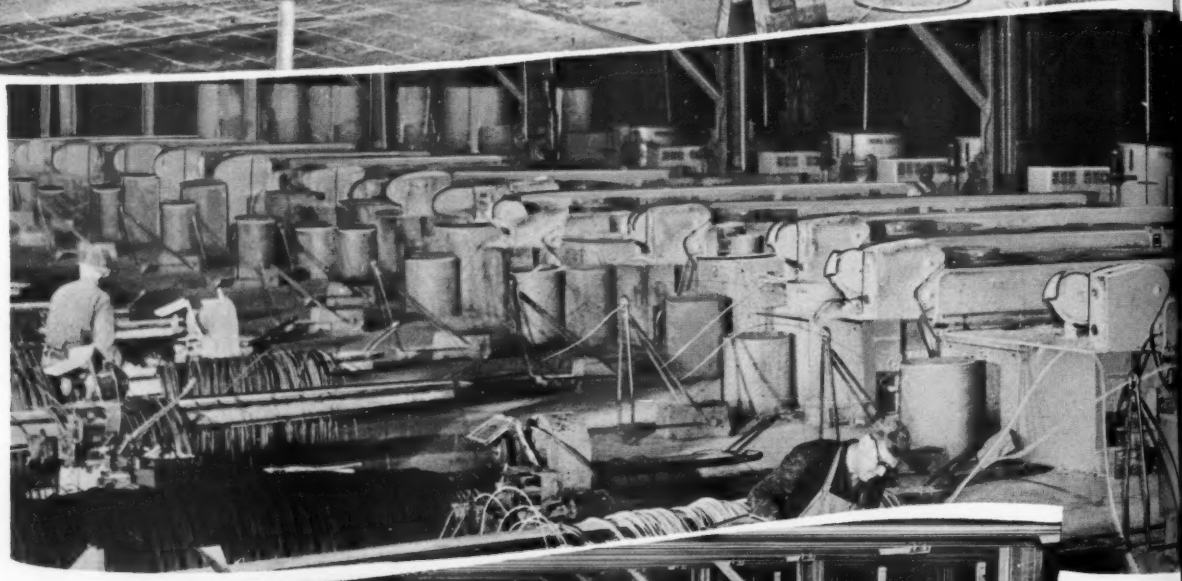

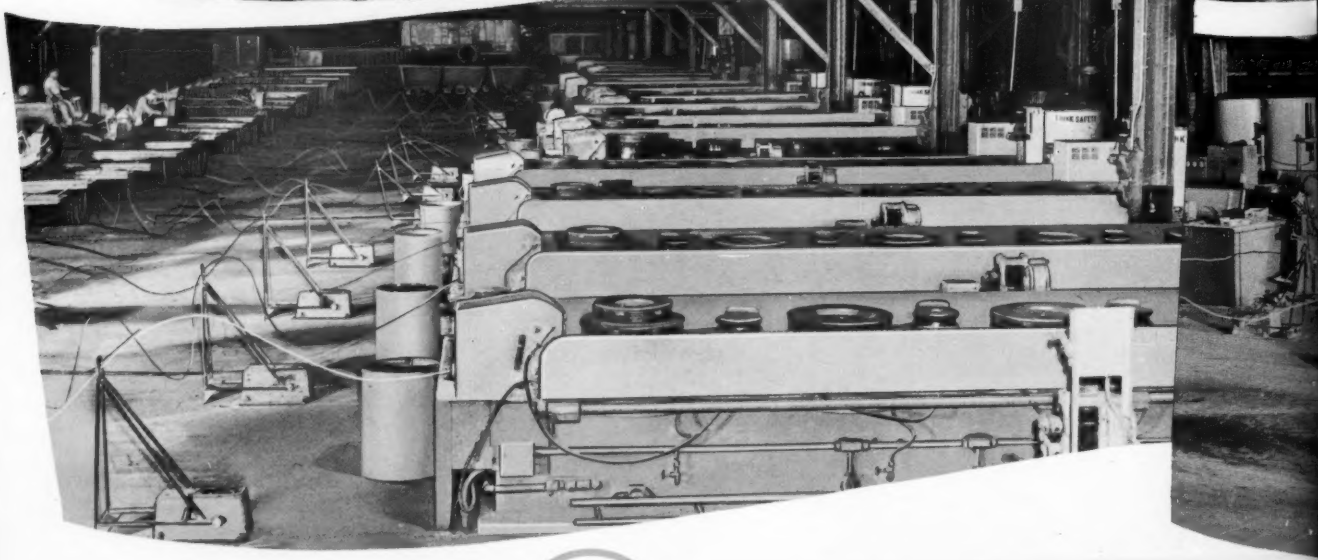

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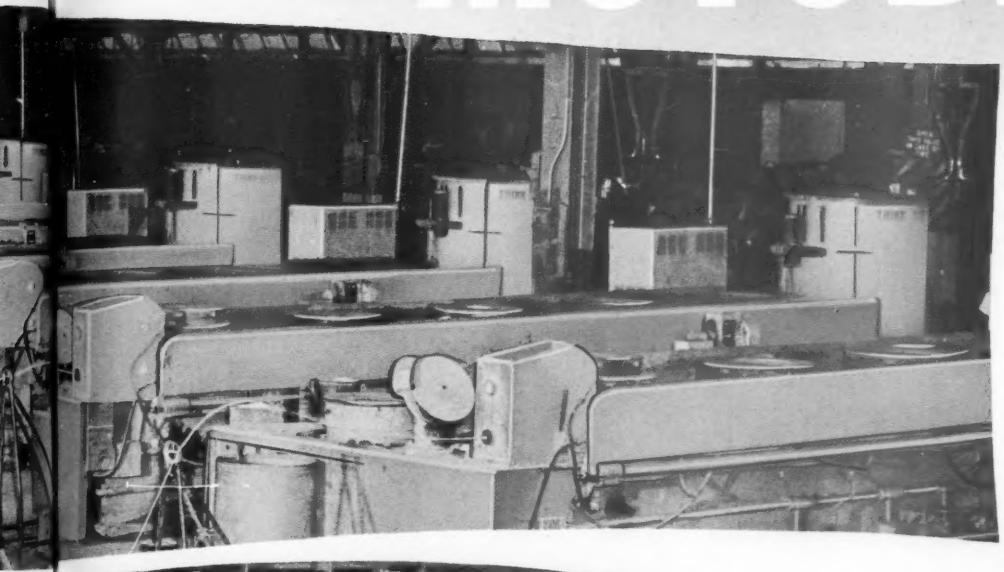

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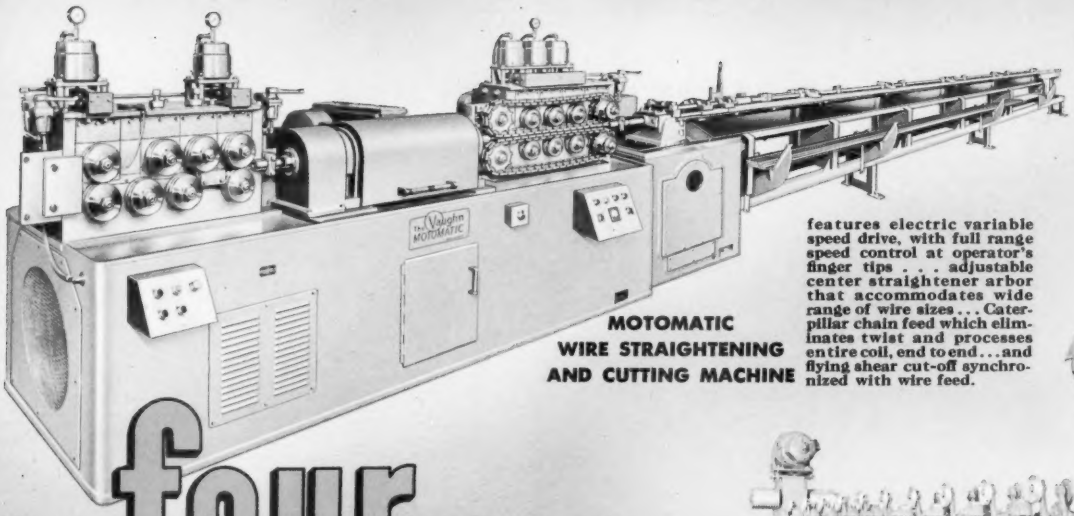

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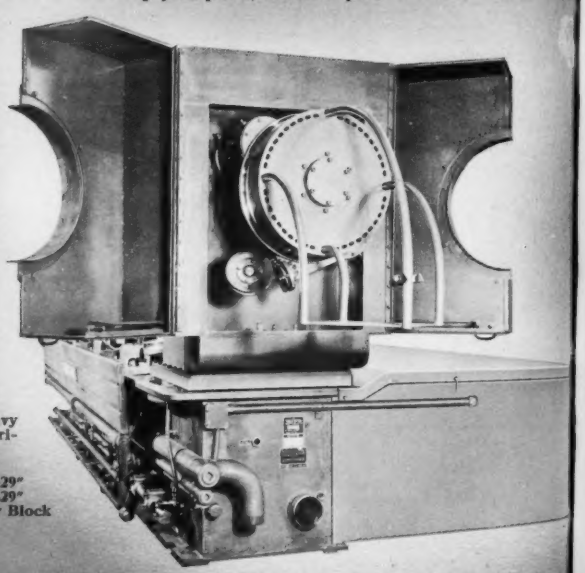

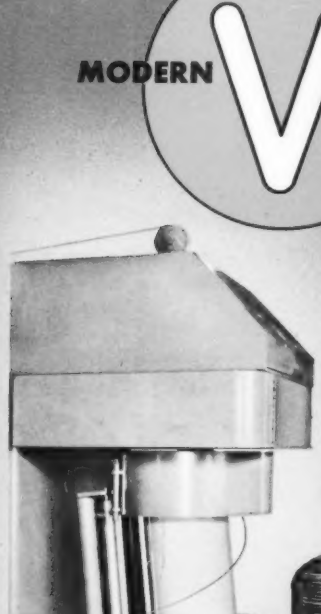

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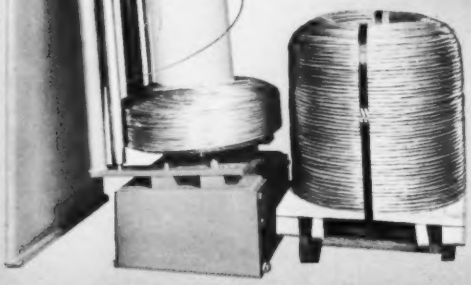

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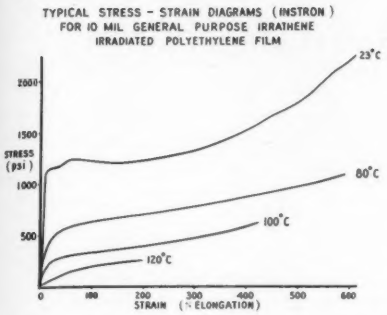


Figure 3 * * * * * * * *

material, while at higher temperatures it becomes a soft rubber-like material. At high temperatures, it actually behaves like an ideal rubber, deforming in proportion to load.

Applications of Irradiated Polyethylene in Wire and Cable

Irradiated polyethylene films and tapes are used now in many types of wire and cable insulation. These include low voltage power cable, aerial telephone cable, aerial distribution cable, service drop cable, control cable and hook-up wire. Other applications include lead wire, motor lead cable for submersible motors, protective wrap for sheathed cable, and as a splicing tape for cable joints.

* * *

Irradiated polyethylene has been evaluated as a replacement for varnished cambric in low voltage type AVA power cable. This cable is now available commercially. Tests on this cable have shown that the irradiated polyethlene provides better heat and moisture resistance than the varnished cloth.

* * *

Typical of the constructions tests was the following 600 volt cable:

1/0—19W copper conductors

2 layers of 0.010″ Pyrotex tape #9523

3 layers of 0.010″ Irrathene® 201 tape

3 layers of 0.010″ Pyrotex tape #9523

Braid 14/2/2 asbestos and glass

Saturant M-240

210-140 Black Finish

* * *

® Registered tradename of General Electric

This cable is of similar construction to the NEMA standard for AVA type cables of the same rating (2). The difference is that 0.030″ of irradiated polyethylene were used instead of 0.030″ of varnished cloth. This cable and a standard control sample cable were tested according to the NEMA standards in WC-1-1955. The control sample was wrapped with 0.036″ of varnished cambric, 20% more than that recommended and greater than the thickness of the Irrathene use.

* * *

In all of the tests, both cables far surpassed the minimum requirements set by the Standard. To differentiate between them, they were subjected to increasing voltages in each test until breakdown occurred. The results are shown in figure 4, where average breakdown voltages are listed for each test. The tests were made as

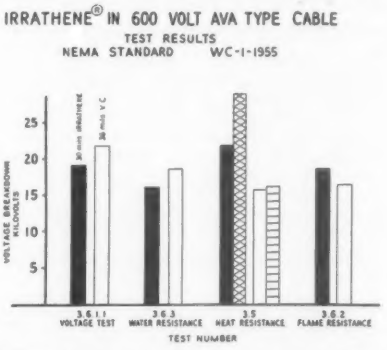


Figure 4 * * * * * * * *

follows: (This data is presented through the kindness of Mr. W. G. **Dahlstrom** of the American Steel and Wire Corporation).

Test Number 3.6.1.1 (voltage resistance)
Three five foot sections of the cable were wrapped so that the center three feet were enclosed in metal foil. Voltage stress was applied. The 600 volt cable must withstand 3KV for five minutes. Voltage was then raised to breakdown.

Test Number 3.6.3 (water resistance)
The samples were three five foot sections with the center three feet immersed in water at room temperature for one hour. The 600 volt cable must withstand 1200 volts for one minute while immersed.

Test Number 3.5 (heat resistance)
Three two foot sections were heated in an oven for 18 hours at 120°C (10° above the maximum specified operating temperature). The center six inches were wrapped in foil after cooling. The 600 volt cable must stand 3KV for one minute.
(On the figure the cross hatched bars represent each of the two types of cable which had been heated for 48 hours at 130°C. This temperature being sufficient to cause shrinkage and sealing of the irradiated polyethylene)

Test Number 3.6.2 (flame resistance)
After passing the flame test (3.4) three two foot sections of cable had the charred area wrapped with metal foil. The 600 volt cable had to withstand 900 volts for one minute.

* * *

In the above tests, the results for the 30 mil Irrathene® irradiated polyethylene insulated cable are excellent, especially when compared to the thicker varnished cloth insulation. In the tests where heat was applied to the cables, the irradiated polyethylene insulated cables were superior to the varnished cloth.

* * *

The benefit of the shrinkage and bonding is even more impressively illustrated in the tests shown in Figure 5 and Table 4. The figure

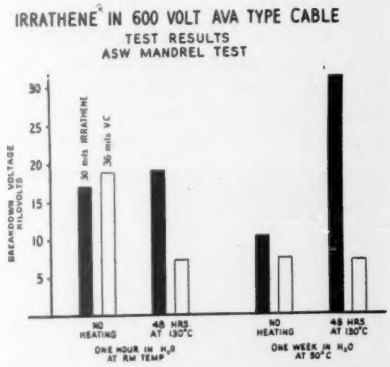


Figure 5 * * * * * * * *

Table 4

Insulation Resistance
(megohms per 5 Ft.)

Days Immersed	Irradiated Polyethylene		Varnished Cloth	
	Not Heated	Heated	Not Heated	Heated
1	143,000	247,000	12.6	53.2
7	144,000	333,000	7.2	57.0

shows voltage breakdown data, and the table, insulation resistance values for cables submitted to bending and immersion test. The breakdown data were obtained in two separate tests. In both, tests were made on unheated cable, and on cable heated at 130°C for 48 hours. The samples were three five foot long sections of each cable. They were wrapped about a mandrel

(*Please turn to page* 1407)

The Rolling of Round Wire into Flats and Rectangles

by Alexander F. Sperduti
Assistant Chief Engineer
The Fenn Manufacturing Company
Newington, Connecticut

Introduction

Since the subject of rolling flat wire is very broad, complicated and sometimes controversial, I shall limit my discussion here to those factors that should govern the selection of the proper mill, the electrical drive, and that highly important subject of mill accessories.

* * *

The two commercially accepted methods of producing what we call flat wire are rolling and slitting. (Figure No. 1) The former method is generally accepted where the width of the desired product does not exceed 1¼" and where the thickness does not exceed ⅜". Within these limitations as to width and thickness we find the product of the flat wire mill.

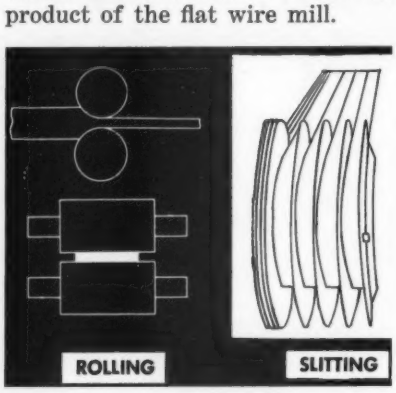


Fig. No. 1 * * * * * * * *

Now the rolling of round wire into flats to meet the modern production demands for stock of superior quality in greater quantities has brought about the development of today's high speed wire flattening mill. (Figure No. 2) The modern flat wire mill offers better control of thickness as well as width with simple roll opening by manual, push botton or automatic control. Even the changeover from one size to another is now only a matter of minutes providing the correct starting round has been determined and often the same entry wire size can be used to make a variety of finished flats.

Alexander F. Sperduti

The author holds a B.S. degree in Mechanical Engineering from the University of Connecticut, which he earned after a period of service in the U. S. Army. He joined Fenn in 1951 as a Design Engineer and became Assistant Chief Engineer in 1955. He prepared this article for presentation at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

Fig. No. 2 * * * * * * * *

* * *

I would like to touch briefly on the availability of round wire as an important consideration to the rolling of flats. As we know round wire is produced in a number of standard wire gages, any one of which can be supplied quickly by many wire drawing companies throughout the country.

In many cases, a standard wire gage size will be correct for a given finished flat, and can be purchased inexpensively. However, if an other-than-standard size is needed, it also can be supplied at a slight increase in price. The tolerance quality of drawn wire is very close, and generally will cover all requirements for wire rolling. In this group I believe we need to go into this no further.

* * *

Tolerance now obtainable by rolling wire into flats is another very important advantage in today's modern mill. Providing the Rolling Mill is of adequate capacity for the job it is to do, and the bearings, roll bodies, and journals have been precision ground for concentricity, a thickness tolerance of plus or minus .0005 is obtainable. Other techniques, which will be discussed later, can be used to further reduce thickness tolerances to ±.0001. Width tolerances of ±.001 are achieved with the use of bright annealed drawn wire as entry stock, and allowing the width to take its natural shape. This tolerance can also be improved by the use of edging equipment built into the Rolling Mill. Further operations on the wire, such as deburring, or polishing, are unnecessary for unlike the slitting method, no burrs are formed in rolling.

* * *

Finish on the stock is in large part dependent on the finish on the roll surface, and also to some extent on the rolling lubricant, if any is used. An ordinary roll finish of approximately 16 micro-inches will impart to the stock, exactly the same finish.

* * *

The tensile strength of flat wire obtained by rolling is, of course, important. Rolling cold works the

metal, thereby increasing its tensile strength. There is a limit to the amount of cold working that is possible, especially with brass, high carbon steel, and steel alloys. This limitation can be overcome by intermediate annealing between roll passes.

* * *

Wire flattening is not limited to the rolling of natural edged flats. Square edged rectangles, (Figure No. 3) trapezoids, ovals, half rounds, and many other shapes can be rolled with the proper selection of equipment.

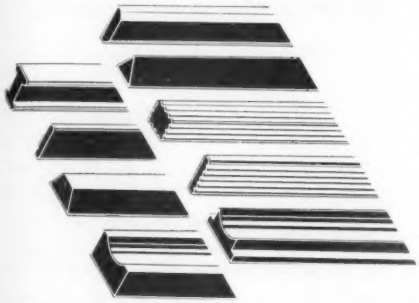


Fig. No. 3 * * * * * * *

Basics Of A Rolling Mill For Wire Flattening

The basic equipment, of course, is the rolling mill itself. (Figure 4). The minimum requirements in a mill are:

1) **precision-made bearings, and rolls;**
2) **an adequately rugged housing for rolls, and bearings to minimize deflection under load;**
3) **a means of adjusting rolls and, at the same time adjustable for leveling purposes;**
4) **a means of driving the rolls through universal joint couplings;**
5) **a system of gears to divide the load between the two rolls, and drive the surface of the rolls at a desired speed;**
6) **a driver such as an electric motor.**

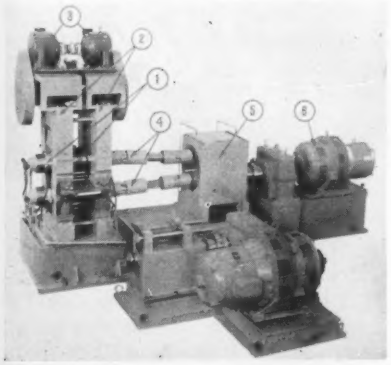


Fig. No. 4 * * * * * * *

The Pay-Off Reel

In order to supply wire to the mill, a pay-off reel is necessary. Basic requirements for a pay-off are a means of holding the wire so it will unwind only as desired and means of braking the coil so the wire will not continue to unwind after the mill has stopped. If the wire being used is in the loose coil form, a horizontal basket type revolving reel can be used. If the wire is in the form of a traverse-wound spool or bundle, a spindle type reel should be used. In most cases, the wire is unwound from the reel by the pull of the wire itself. This pull is imparted to the wire by the rolling friction. If, however, a combination of a very high pay-off speed and a heavy bundle exists, the pay-off reel should be driven by its own motor. There are many other types of pay-off equipment, much of which has been devised, and developed by the users of wire flattening equipment. For example, some wire suppliers sell round wire in pay-off packs that can be used directly as pay-off reels. The wire is pulled out of the barrel a single strand at a time.

The Take-Up Reel

The wire, having been rolled, must now be wound in some manner into a unit which can be conveniently used for subsequent operations — hence, the take-up reel. There are two principal types of take-up reels . . . the traversing take-up reel and the shedding drum type.

* * *

The traversing type, accepts the wire either on a spool or on a collapsible drum. I will depart a moment and describe the difference between a spool and a collapsible drum. (Figure 5) Both have the same general appearance, e.g., a cylinder with a flange on each end for retaining the wire. The spool is essentially one piece and is removable with the wire coiled in it. The collapsible drum is permanently attached to the reel except for a front flange. The front flange is easily removed so that after the cylinder portion of the drum has been collapsed, the bundle of wire can be removed. The drum will be ready for more wire after the cylinder is expanded to its original

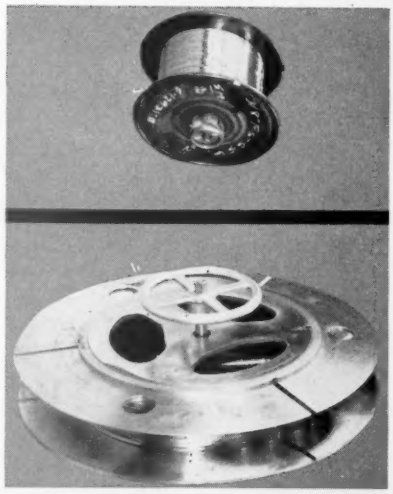


Fig. No. 5 * * * * * * *

diameter and the front flange is replaced.

* * *

Now, to return the traversing reel—it consists of a spindle which occillates from one side to the other at a rate which can be easily varied by the operator. The rate of traverse or occillation can be changed for different widths of wire by a handwheel. The spindle may be driven by a chain drive, deriving its power from the rolling mill motor, and its speed is synchronized by the use of a friction clutch which slips to enable the surface speed of the spool to be equal to the speed of the wire coming out of the mill. The spindle can be driven by its own motor, thereby requiring electrical speed control. A separate drive becomes essential when constant tension on the wire is desirable during coil build up.

* * *

A second type of reel is used to produce a shedded or loose coil. This type is used in conjunction with Turks Heads, which I will discuss later. Its function is to pull the wire through a Turks Head, and continuously shed the wire in a lateral direction, thereby forming a loose bundle. Of necessity, these shedding drums must be of extremely rugged construction for high pulling forces that are often required.

The Turks Head In Rolling Flats

A Turks Head (Figure No. 6) can be described as two rolling mills together, one rolling in a

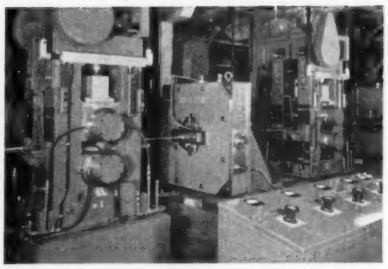


Fig. No. 6 * * * * * * * *

horizontal direction, and the other rolling in a vertical direction, and in which the axies of all the rolls are in the same plane. This permits the rolling of squares, rectangles, and trapezoids, among other shapes. Unlike the rolling mill, however, a Turks Head is generally friction-driven, which necessitates the use of a shedding drum or a capstan to pull the wire through. In special cases, Turks Heads are power-driven. However, the limitation on power Turks Heads is the torque transmitting restriction imposed on it by limited space for torque bars. In the case where loads are light, a power Turks Head serves very nicely. Here are several typical wire flattening lines with Turks Heads (Figures No. 7, 8 and 9).

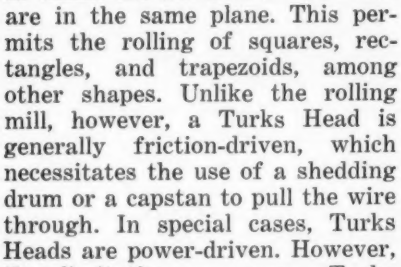


Fig. No. 7 * * * * * * * *

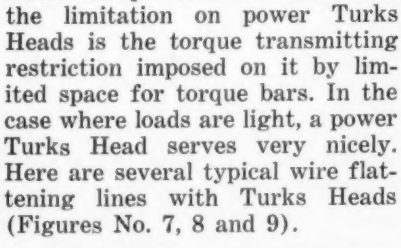


Fig. No. 8 * * * * * * * *

The Edger

An edger (Figure No. 10) is another basic accessory used in the wire flattening industry. It is generally placed between stands of tandem rolling mills, and its purpose is for edge control of flattened wire. With an edger, a flat or radius edge can be formed on the wire.

* * *

An edger, like a rolling mill, must have precision bearings and rolls in order to assure precise width tolerance. It also should have a sturdy housing, and a means of easily adjusting roll opening for setting the exact wire width. It can be friction-driven by the wire . . . it can be driven through a chain drive, which derives its power from the mill motor . . . or it can be separately driven with its own motor.

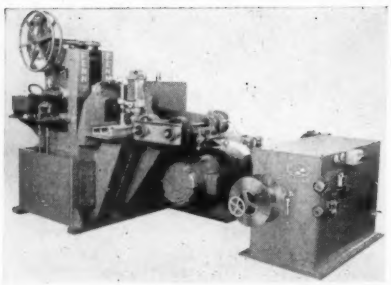


Fig. No. 9 * * * * * * * *

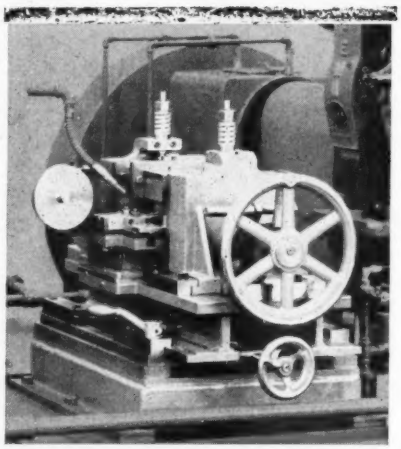


Fig. No. 10 * * * * * * * *

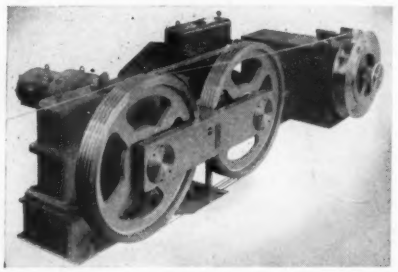


Fig. No. 11 * * * * * * * *

The Double Capstan

The last basic accessory to be discussed, is the double capstan (Figure No. 11). It consists of two driven wheels, a frame, and a driving unit. It is mainly used to pull wire through a Turks Head in the same way as a shedding drum would. Unlike a shedding drum, the wire is not bundled on the capstan, therefore, necessitating the use of a traversing or other reel in conjunction with it. The advantage of the double capstan, is that there is no lateral rubbing of the wire as on the drum surface of a shedding drum. This eliminates the possibility of marking the stock. A relatively light tension on the exit end of the wire coming off the capstan, which is exerted by the take-up reel, permits a much greater pull to be applied to the wire coming through the Turks Head. This is produced by the friction force between the wire, and capstan wheels, which is greatly increased by the multiple wraps around the wheels by the wire.

* * *

All of the basic accessories which I have described can be incorporated into the mill, or wire line, in many different combinations, to best meet each specific requirement. Here are a few examples. (Figures No. 12, 13, and 14).

Determining Proper Mill Size

The first consideration in selecting a rolling mill for a specific job is roll diameter. A chart has been developed (Figure No. 15), from experimental data for the purpose of selecting roll diameter and number of Mills, and/or entry wire size needed for a given finish natural edged flat. The chart, as shown, is for 8 inch diameter rolls. However, by multiplying the width, and thickness by the ratio factors of roll diameter as directed on the chart, the same chart can also be used for 6, 11, and 14 inch diameter rolls. Notice the curves for first pass limit and second pass limit.

* * *

These curves indicate the limits to which wire can be flattened without exceeding plus or minus .002 inch in width tolerance. The skid limit curves show the points where the limit is set, not by width tolerance, but by maximum

Precision Copper Commutator Bar Line

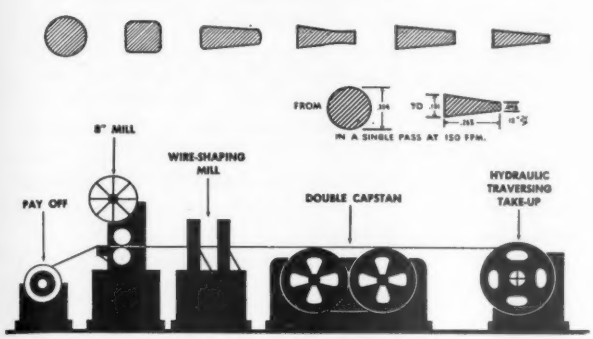


Fig. No. 12 * * * * * * * * * * * *

Heavy Duty Multiple Stand Wire Flattening Mill

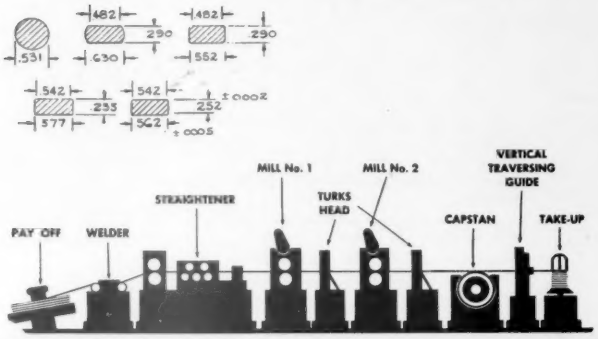


Fig. No. 13 * * * * * * * * * * * *

Compact Single Stand Wire Line

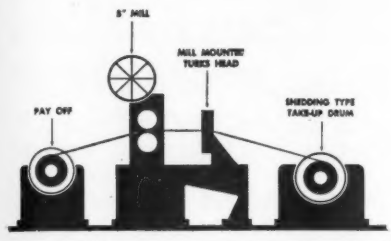
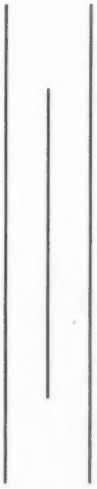


Fig. No. 14 * * * * * * * *



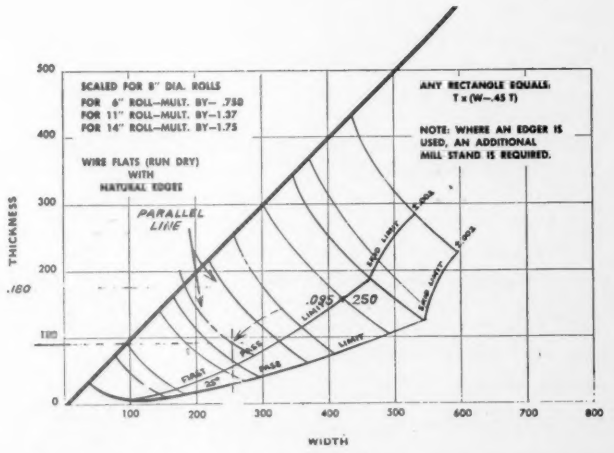


Fig. No. 15 * * * * * * * * * * * *

vertical reduction that can be taken without causing roll slippage. From experimentation, it has been shown that this maximum vertical reduction equals roll diameter divided by 50 from a round wire to a flat, and a roll diameter divided by 100 from a flat to a flat. This chart has been made from data obtained by the rolling of low carbon steel wire without the use of an external lubricant.

* * *

Assuming a flat .095 x .250 is to be made (see print on chart), it can be seen that an 8 inch diameter roll will handle this size very adequately. This same point also represents .070 x .187 using .75 as a factor for a 6 inch roll; .106 x .437 using 1.75 as a factor for a 14 inch roll. Now if a line is drawn parallel to the nearest curve, and through the point until it intersects the straight 45 degree line, and then carried horizontally through the thickness line, it is seen that the starting round is .180 in diameter. It has been shown that this particular size can be rolled in one pass, in a one stand mill which has a 8 inch diameter roll. It is now necessary to determine the capacity required in a mill from a separating force (bearing load), and torque standpoint. Presented here are three formulas (Figure No. 16) which have been based on a scientific derivation, and modified by experimental and practical data.

* * *

By the use of Chart F-156, and listed formulas, and the known speed at which the machine has to be run to meet production requirements, a mill and drive can be selected. Drives will be discussed in more detail later.

* * *

Assuming that the same size, mentioned previously, (.095x.250), is now to be made with a square edge, the first pass limit now becomes the second pass limit. The reason for this is that an edger must be used to flatten the edges, and in order not to upset this edge, only a very light second pass can be taken. To produce the above, a rolling mill, an edger, and a second mill, are required. If the finished rectangle must be absolutely square cornered, a mill, Turks Head, capstan, and take-up reel would be used. If a loose bundle is satisfactory, a shedding drum can be used. For the same reason as stated above, the second pass limit now becomes the third pass limit when a flat edge is desired. Where production allows, instead of a 2-Stand or a 3-Stand tandem mill, the wire can be re-passed through the same mill two or three times.

* * *

Listed below (Figure No. 17) are examples of what can be done on a Two-Stand Mill with 6" diameter rolls, an edger, and a traversing take-up reel, and also with a similar line having 8" diameter rolls (Figure No. 18). The reason why maximum entry diameters are not larger than those shown, is that the resulting, possible width to

WIRE FLATTENING FORMULAS FOR DETERMINING PROPER MILL SIZE

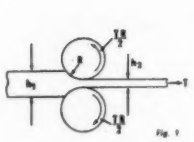


Fig. 1

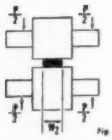


Fig. 2

IF:

P = separating force between upper and lower roll, in pounds;

R = radius of the working roll, in inches;

TR = total torque required to drive both rolls; in inch pounds;

T = tension required to pull wire through rolls which are not driven, in pounds;

HP = horsepower required to drive the rolls at a given speed;

and

h_1 = diameter of entering stock, in inches;

h_2 = thickness of rolled stock, in inches;

w_2 = width of rolled stock, inches;

(T.S.) = tensile strength of material before rolling, in psi (pounds per square inch);

THEN:

Separating Force =

$$P = f \times 1.5 \times (T.S.) \times w_2 \times \sqrt{R \times (h_1 - h_2)}$$

Torque =

$$TR = f \times 1.5 \times (T.S.) \times w_2 \times R \times (h_1 - h_2)$$

Tension = $T = f \times 1.5 \times (T.S.) \times w_2 \times (h_1 - h_2)$

Horsepower = HP =

$$\frac{f \times 1.5 \times (T.S.) \times w_2 \times (h_1 - h_2) \times \text{ft. per min.}}{33{,}000}$$

Where "f" values depend upon the finished width to thickness ratios as follows:

$\frac{w_2}{h_2}$	1.1	1.2	1.3	1.5	1.7	1.9	2.4	2.7	3.0	4.0
f	.21	.29	.35	.39	.43	.46	.50	.55	.60	.80

Maximum vertical reduction that can be taken without causing roll slippage equals

$$\frac{\text{ROLL DIAMETER}}{40}$$

Minimum practical gage that can be rolled equals

$$\frac{\text{ROLL DIAMETER}}{1000} \text{ for steel}$$

down to $\frac{\text{ROLL DIAMETER}}{2000}$ for softer materials

up to $\frac{\text{ROLL DIAMETER}}{300}$ for harder materials

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Fig. No. 16 * * * * * * * * * * * * * * * *

TANDEM MILL CAPACITIES

6" TWO-STAND

WITH EDGER & TAKE-UP

MAX. ENTRY ROUND	.328
MAX. VERTICAL-REDUCTION	.120
MAX. FINISHED RECTANGLE	.210 x .390
MAX. W/T RATIO	2.5 @ .135 x .345
	2.8 @ .105 x .300
	3.7 @ .060 x .225
	4.8 @ .039 x .187
	6.7 @ .022 x .150
	12.0 @ .007 x .084

Fig. No. 17 * * * * * * *

TANDEM MILL CAPACITIES

8" TWO-STAND

WITH EDGER AND TRAVERSING TAKE-UP REEL

MAX. ENTRY ROUND	.437
MAX. VERTICAL-REDUCTION	.160
MAX. FINISHED RECTANGLE	.280 x .520
MAX. W/T RATIO	2.5 @ .180 x .460
	2.8 @ .140 x .400
	3.7 @ .080 x .300
	4.8 @ .052 x .250
	6.7 @ .030 x .200
	12.0 @ .003 x .110

Fig. No. 18 * * * * * * *

thickness ratio from such a wire size would be very small. There are other more practical methods of producing such a section.

* * *

If the width to thickness ratio is less than two to one, a line including two Turks Heads, and a shedding drum (or a capstan, and a take-up reel) would be used. The first Turks Head roughs out the required section from a round wire, and the second Turks Head sizes it accurately. Since the above eliminates a rolling mill, and requires only one drive motor, the economy of such a line is obvious.

Selecting The Proper Drive

Having decided on the proper combination of basic rolling machinery, it remains to select the drive. The basic steps which should be taken in selecting a drive for each rolling application will be outlined.

* * *

Since cost is usually a basic consideration, the objective then is to determine the type of drive that meets the rolling requirements, and also represents a sensible solution to the economics involved.

* * *

We first try to determine whether a single speed drive can be used, since variable speed drives cost more and this cost increases in direct proportion to the flexibility required. A single speed drive can be used if there is only one motor in the line, and the line does not have to accelerate from standstill to more than 100 FPM. The single speed motor then becomes a simple AC motor and the control an AC motor starter.

* * *

Most other conditions require a variable speed motor. The determining factors usually are:

1) **The necessity of smoothly accelerating the mill from standstill to ultimate speeds exceeding 100 FPM.**

2) **Other separately driven units in the line: e.g., a take-up reel, an edger, another mill stand.**

If a variable speed drive is indicated, it is very tempting to make what may seem to be the next logical decision, a choice between AC or DC current. Tempting as it may be, this decision should be delayed until the following have been carefully considered, namely, constant torque vs. constant horsepower. While the constant torque requirement can be filled by either AC or DC, the constant horsepower requirement most always leads to DC. In working with a variable speed motor, one cardinal rule must be observed. There is no such thing as a horsepower rating without reference to a specific speed. Since power is the work done divided by the time required to do it, power cannot be computed without knowing the time element, speed.

* * *

The answer as to whether constant horsepower or constant torque should be established as the preferred drive, lies in the plotting of a horsepower-speed curve. Using the same basic horsepower formula as given previously in this article, and substituting, for speed, the speed of the particular pass rather than that of the mill, a series of points are plotted, each representing the horsepower required to take a given reduction at a given speed in accordance with the production requirements. This series of points, not less than four in number, creates a horsepower — speed curve similar to that shown in Figure No. 19.

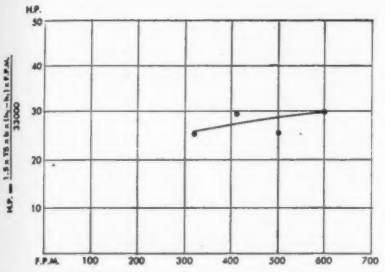

Fig. No. 19 * * * * * * *

With the above typical horsepower-speed curve, evaluation of constant torque vs. constant horsepower will be made.

* * *

Constant Torque

If the horsepower-speed curve indicates increasing horsepower requirement as the rolling speed increases, a constant torque type of drive may be indicated. Bear in mind that the constant torque characteristic is a straight line curve starting at zero horsepower-zero speed which must intersect a point on the curve so that all other points established fall below it. Having plotted the straight line curve the rated horsepower of the motor required can be obtained by drawing a vertical line representing maximum mill speed to intersect the straight line curve. The graph (Figure No. 20) will assist you in following this procedure.

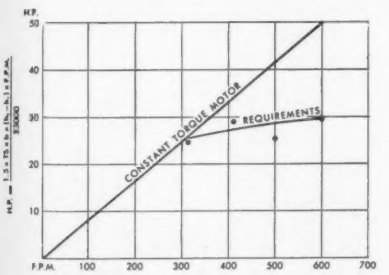

Fig. No. 20 * * * * * * *

Now we can proceed to evaluate constant horsepower .

Constant Horsepower

If the horsepower-speed curve indicates constant or decreasing horsepower with increasing speed, a constant horsepower drive may be indicated. Bear in mind that a full knowledge of the many types of constant horsepower drives is required before the proper selection can be made but in simple terms the rated horsepower of the motor required must be equal to the maximum horsepower indicated in your plotting. This constant horsepower drive usually results in the decision to take the heaviest reductions at the slower rolling speeds. The graph (Figure No. 21) will indicate the basic approach used in constant horsepower drive selection.

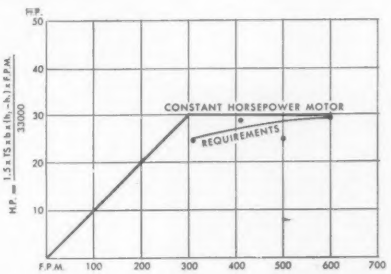

Fig. No. 21 * * * * * * *

At this point a definite indication of the best drive should be apparent. (It will be noted that the above example graphs would lead to the recommendation of a constant horsepower drive.)

* * *

Now we can get back to AC or DC. If a constant torque variable speed drive had been indicated, either AC or DC drives are commercially avaliable. The selection between the two types would be determined by economic or factory conditions which would lead to a preference for one or the other. If a constant horsepower type of drive was indicated, a DC drive will most likely prove to be the only solution, but here economic considerations must be examined and comparisons made.

Rolling Techniques

Up to this point, only basic considerations have been discussed. There are many rolling techniques which are used in order to obtain good quality wire, some of which require additional equipment. Time permits me to only mention a few necessary accessories briefly. Guiding the wire into a mill, edger, or Turks Head is very important if straight wire is desired. A straightener is often required to give a finished product that is free of kinks or dog legs.

Dancer Rolls

When running small section wire (up to .050 x .200 in steel) at a high rate of speed in a tandem line, the tension between stands becomes very critical. Due to minor changes that take place in the homogeneity of wire, and in relative mill speeds, the tension between stands is constantly varying. In larger sections, the wire is strong enough to force the drive motor to maintain a correct speed without stretching the wire. In smaller sections these variations can change the size of the wire, thereby losing tolerance. The answer to this problem is the use of dancer rolls between mills, and also in some cases, between the last stand, and the take-up reel. The dancer rolls should exert a constant tension on the wire, and at the same time should have some means of automatically controlling the relative speeds of the units the dancer is set between, so that it will remain within a certain range of positions. This is called its storage. With proper controls, an operator could thread a wire through a tandem line using dancer rolls, and accelerate the line to a very high speed, run at that speed for a period of time, and decelerate to a stop without losing tolerance. If a dancer roll is not being used (which is only if smallest section rolled is not less than approx. .020 x .187), the controls on the take-up reel should be such as to maintain a constant tension on the wire, not only during acceleration, and deceleration, but also while the wire is building up on the reel.

* * *

Another very important factor to consider in attempting to maintain very close tolerances is the expansion of the rolls during warm up time.

* * *

Theoretically, if the tension between stands is kept constant, and there is no increase in roll temperature, a wire can be rolled which has zero tolerance, providing the round wire has no variation in its diameter. It is impossible to keep the temperature change of the rolls to zero, but much can be done to keep the change down to a few degrees Fahrenheit. Coolant can be

(*Please turn to page* 1409)

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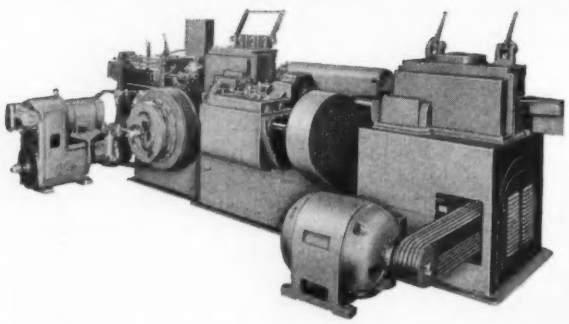
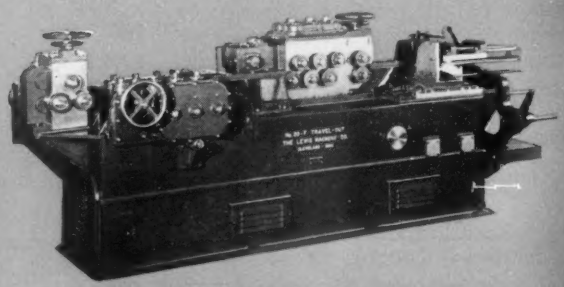


Lewis No. 11-FA Travel-Cut with Flying-Shear Cut-Off. Capacity ½" to ¾" diameter, 75-175 FPM. Rear view with guards removed showing Air Clutch and drive.

The combination of Air Brake, Air Clutch and Variable Speed Drive permits higher cut-off speeds... and allows infinite adjustment of the flywheel for perfect synchronization of cut-off and wire feed speeds... rod can be cut WITHOUT SPOT SWELL.



Lewis No. 20-F Travel-Cut SHAPE Straightening and Cutting machine. Capacity 5/16" to 5/8" square, hex or equivalent area in flat stock.

The Travel-Cut Flying-Shear Cut-Off is particularly advantageous on shape machines to better synchronize the cut-off with the through speed of the wire. This is necessary to eliminate roll rub marks and reduce roll wear to a minimum.

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The new Lewis No. 12-FA High-Speed, Flying-Shear type Wire Straightening and Cutting Machine is now being developed to handle rod up to 1" in diameter from coils at output speeds much greater than on any existing equipment.

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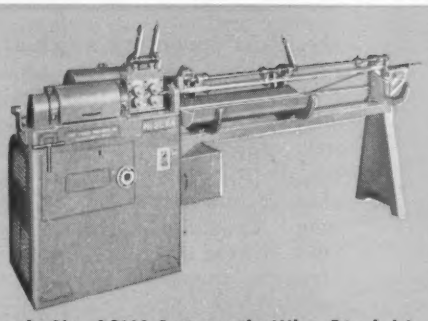
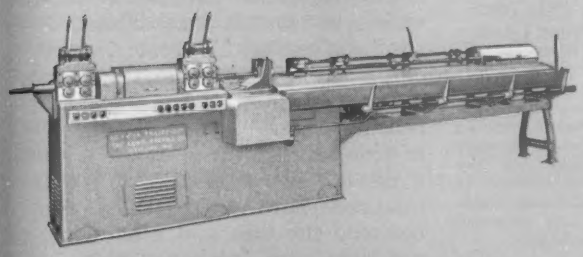


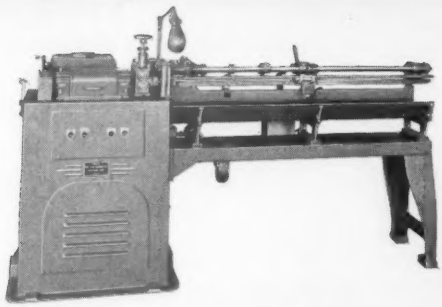
Lewis No. 2CV4 Automatic Wire Straightening and Cutting Machine with variable speed drive and Dual-Center Straightening Arbor. Capacity 1/16" to 1/4" diameter. No. 2CV5 Capacity 1/16" to 5/16" diameter. Feed speeds up to 200 FPM.

The Lewis 2CV Series can be quickly converted to handle shapes by installing our interchangeable Roll Straightener in place of the Dual-Center Rotary Straightener Arbor.



Lewis No. 4-FHA Travel-Cut Automatic High-Speed Flying-Shear Wire Straightening and Cutting Machine with Wichita Air Clutch and Air Brake. Capacity Mild Steel, 3/32" to 1/4" diameter. High Carbon, Alloy and Stainless, 3/16" diameter. Speeds up to 500 FPM.

The Dual-Center Straightener Arbor (Pat. Pend.) permits use of close centers for small diameters and long centers for the larger diameters for precision straightening over entire range of machine.



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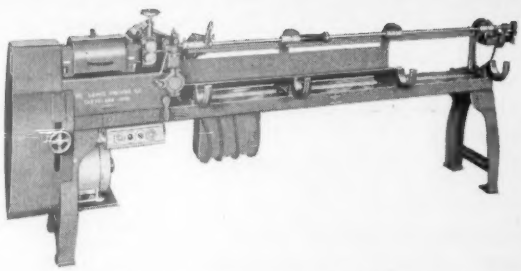

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Aerial Tow Members

by Jack E. Tiede

Target Development Laboratory
Air Proving Ground Center
Elgin Air Force Base
Florida

There is an urgent and continuing requirement for aerial tow members. At the present time, the primary limiting factor of existing tow systems is tow member scope. Thus, significant improvements in tensile strengths and tow member drag must be effected inasmuch as target drag has been largely minimized.

* * *

It may appear that the utilization of tow targets is relatively unimportant and is not a necessity with the advent of the missile age. However, an examination of existing targets and their limitations indicate that towed targets will continue to be utilized to fulfill an appreciable percentage of the requirements for air-to-air training of combat air crews in gunnery, rocketry, and missile firing. Because of the increased emphasis on missile training, this discussion will be confined primarily to the requirements of targets for missile training.

* * *

At the present time, it is within our defense capability to provide three types of targets: rocket-powered, drone, and towed. It is realized that a valid requirement for all three types of targets will continue to exist for some time. However, the inherent disadvantages of both the rocket-powered targets and drones will necessitate substantial utilization of towed targets. The rocket-powered target has severe limitations in that it provides a useable target for a relatively short period of time while drone targets are relatively expensive and have a substantially lower reliability than tow systems. Nevertheless, both the rocket-powered target and the drone target should be kept in the Air Force inventory to provide realistic targets at altitudes, speeds, and ranges not attainable with towed targets.

Jack E. Tiede

The author is a graduate of the Missouri School of Mines and Metallurgy and holds a degree of B.S. in Chemical Engineering. He also attended the U. S. Naval Academy from 1936 to 1938 and the St. Louis School of Watchmaking (1948-1949).

He spent five years as a Sales Engineer for the Mechanical Division of U. S. Rubber Co., eight years in active military service (1941-1946 and 1951-1954), during which he was Test Firing Lieutenant and Assistant Gunnery Officer on the U.S.S. Republic, and Executive Officer and Commanding Officer on the U.S.S. Avery Island. He saw police action in Korea as 1st Lieutenant and Executive Officer, Sub-Group, Atlantic Reserve Fleet, and Executive Officer on the U.S.S. Alshain. He entered service as an Ensign and was released from active duty as Commander. He was awarded nine campaign and service ribbons.

From 1954 to the present he has been with the U. S. Civil Service Commission as a Project Engineer at the U. S. Navy Proving Ground in Terminal Ballistics, and three years as Supervisory Engineer with the U. S. Air Force at the Air Proving Ground Center in Aerial Bombs, Rockets and Tow Targets. Special monetary awards have been made to him for Sustained Superior Performances.

He prepared this paper for presentation at the Annual Convention of The Wire Association at Cleveland, Ohio, on October 13, 1959.

Tow systems are normally comprised of a target, target launcher, tow reel with necessary controls, and a tow wire or strand. There is currently a family of four lightweight spin-stabilized targets in the USAF inventory which are being utilized to provide air-to-air rocketry and missile training. These targets have a similar external configuration, weigh approximately 18 to 50 pounds, are 18 inches in diameter, and 96 inches long. Typical construction materials utilized are foam plastic inner strength members covered by a pressed wood fiber shell with fiberglass reinforcement. The MC-3 target (Figure 1) shows the external configuration which is typical of this family of targets. It has

Fig. 1: MC-3 Tow Target

* * * *

a monostatic passive radar reflector constructed of aluminum foil laminated to a cardboard back, which, in turn, is encapsulated by the foam center. The second target of this family is similar to the MC-3 except it has a bi-static radar reflector installed. The next target of this family, the TDU-4/B, has a monostatic radar reflector, four infrared flare holders attached between the fins, and a one channel ultra high frequency radio receiver to activate the flares. The last target of the family of four is the TDU-6/B. This target has a bi-static radar reflector, four infrared flare holders attached between the fins, a one channel ultra high frequency radio receiver to activate the flares, and a proximity scoring device to measure proximity of a missile or rocket to the target. These targets are normally launched between sea level and 5,000 feet at an indicated airspeed of about 230 knots. They are towed at tow lengths from 7,500 to 33,000 feet at pressure altitudes up to 50,000 feet and indicated air-

speeds up to 480 knots or Mach 0.9, whichever is lesser. These targets are currently being towed with 0.034, 0.040, 0.045, and 0.050 inch diameter music wire which has minimum breaking strengths of 295, 397, 491, and 599 pounds, respectively. This wire may normally be expected to perform satisfactorily about ten to fifteen missions before breaking during tow; its performance is dependent upon the weight of the target towed, length of tow, altitude, and airspeed. The wire failure increases rapidly when tow lengths exceed 15,000 feet. The music wire is procured in accordance with the provisions of Federal Specification QQ-W-470a.

* * *

The TDU-9/B tow target shown in Figure 2 is currently under development for supersonic use in missile training. It is approximately 200 inches long, has a basic body diameter of 8 inches, a maximum wing span of 36 inches, and weighs about 230 pounds. All targets will be equipped with a combination parachute-nose spike recovery system, a five-channel ultra high frequency radio receiver, and an air-driven generator. Suitable provisions have been incorporated for the installation of auxiliary equipment required for specialized missions. This equipment includes a scoring device, radar tracking beacon, radar augmentation, continuous infrared source, infrared flares, and smoke puff dispenser. This target is launched between sea level and 5,000 feet at an indicated airspeed of about 230 knots. It is expected to be towed at tow lengths up to 40,000 feet, at pressure altitudes up to 50,000 feet, and at speeds up to Mach 1.5. This target is expected to be towed with a stepped aerial tow strand of two configurations. Two configurations have been selected in order to obtain comparative drag data between armored and unarmored strand, and to determine strand performance on two different types of tow reels. (One tow reel will carry the full system load on the storage drum, whereas a capstan is utilized in the other reel which permits substantial weight reduction of the storage reel and level wind assembly.)

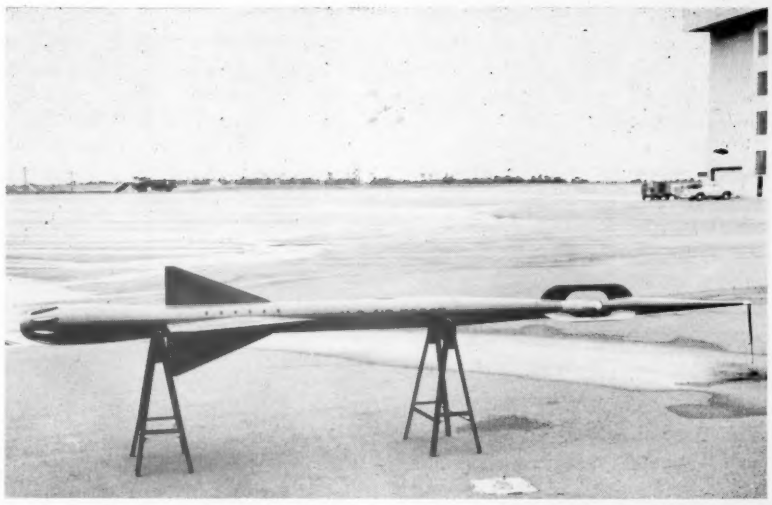


Fig. 2: TDU-9/B Tow Target * * * * * * * *

* * *

The Stepped I aerial tow strand is comprised of 5,000 feet of 1/16 inch 1x7 swaged strand, spliced to 10,000 feet of 3/32 inch armored strand, which, in turn, is spliced to 25,000 feet of 1/8 inch armored strand. The minimum breaking strength is 875 pounds for the 1/16 inch strand, 1,230 pounds for the 3/32 inch strand, and 2,160 pounds for the 1/8 inch strand. The 1/16 inch strand is procured as a commercial item, the 3/32 inch strand in accordance with Air Proving Ground Center Specification ACYT-C1, and the 1/8 inch strand in accordance with Military Specification MIL-C-5765C.

* * *

The Stepped II aerial tow strand is comprised of 5,000 feet of 1/16 inch 1x7 swaged strand spliced to 20,000 feet of 0.081 inch 1x19 swaged strand which, in turn, is spliced to 15,000 feet of 0.115 inch

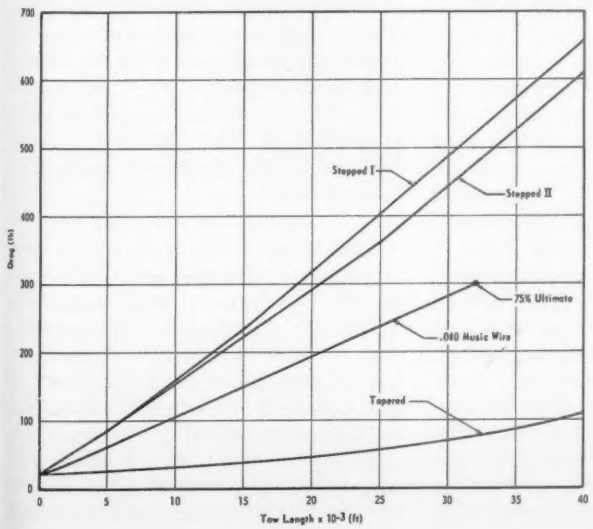


Fig. 3 (At left): Theoretical Tow System Drag for MC-3 Target at 40,000 Ft Pressure Altitude and Mach 0.75 * * * * *

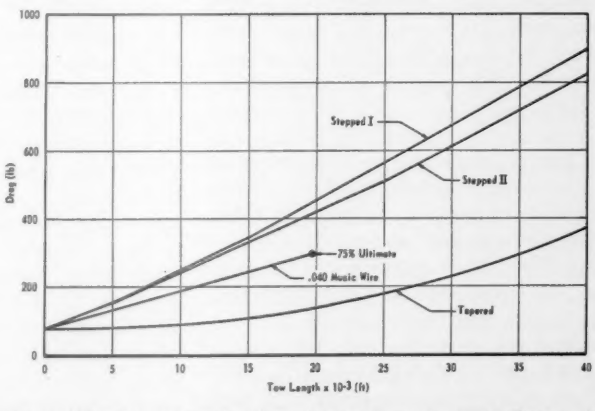


Fig. 4 (Above): Theoretical Tow System Drag for MC-3 Target at 40,000 Ft Pressure Altitude and Mach 1.0 * * * * *

1x19 swaged strand; the respective minimum breaking strengths are 875, 1,600, and 3,000 pounds. These strands are procured as commercial items.

* * *

The maximum tow lengths attainable at every altitude and airspeed are dependent on the tensile strength of the tow member and the drag generated by the target and tow member. The minimum tensile strength of the 0.034 to 0.050 inch diameter music wire currently being procured ranges from 324,000 to 304,000 pounds per square inch. The tensile strengths of the armored strand and commercial strand range from a minimum of 350,000 to 360,000 pounds per square inch.

* * *

Theoretical drag values for the MC-3 target at airspeeds of Mach 0.75 and Mach 1.0 at 40,000 feet pressure altitude are shown in Figures 3 and 4, respectively. (These and succeeding theoretical calculations are based on a thesis, "An Analysis of Aerial Tow Cables," by **William David Mark**, Graduate Student, Massachusetts Institute of Technology, dated 26 May 1958. Consideration of the sharp drag rise generated by the shock wave in the transonic and supersonic ranges would give slightly higher drag values than those shown. The curves for the tapered wire have been based on the assumption that the angle of attack[1] of the wire is very nearly constant and were considered to be negligible, whereas the curves for the stepped and constant diameter numbers have included considerations for variable angles of attack because the effects were appreciable).

* * *

The tapered tow wire is assumed to be a high carbon steel wire with a constant tensile strength of 350,000 pounds per square inch. Assuming that it is subjected to loads of 75 percent of its ultimate strength, the wire would have a minimum diameter of 0.020 inch and taper to 0.042 inch at 40,000 feet. (The configuration and tensile strengths of the other two members are discussed above.)

1 The angle of attack is defined as the angle between the wire and the free stream velocity vector. * * * * * * * *

An examination of the theoretical drag values of the MC-3 target at a pressure altitude of 40,000 feet shows that the target drag at Mach 0.75 and Mach 1.0 is 22 pounds and 77 pounds, respectively. The system drag with 0.040 music wire (target and wire) at a tow length of 20,000 feet at air-speeds of Mach 0.75 and Mach 1.0 are 195 and 298 pounds, respectively. If a tapered tow wire is utilized at Mach 1.0, approximately 15,000 feet additional tow length is available without an increase in system drag. Similarly, the use of the tapered wire when towing the MC-3 target would reduce the system drag by more than 50 percent. The same effect could be achieved by doubling the tensile strengths of existing wire.

* * *

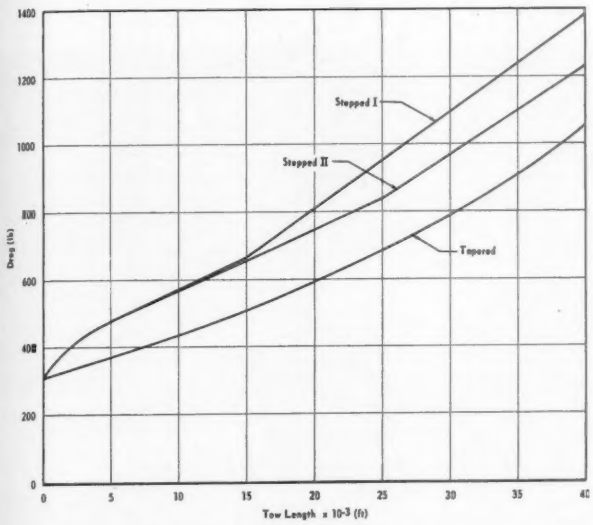
The theoretical values for towing the MC-3 target with two stepped aerial tow strand configurations have been included to illustrate and emphasize that system drag is largely attributable to the tow strand and not the target. However, attempts should never be made to tow the MC-3 target with either of the stepped tow strands because of the probability of the existence of an unbalanced condition between the tow member target. It is realized that the elimination of these unbalanced conditions is clearly the responsibility of the Air Force. However, it is considered appropriate to advise of their existence. An example of an unbalanced tow member-target condition occurred when a target similar to the TDU-4/B target, which weighed approximately 40 pounds, was towed with a 3/32 inch armored strand at 20,000 feet tow lengths, at a pressure altitude of 30,000 feet, and an airspeed of Mach 0.6. Another example of an unbalanced condition occurred when the MC-5 target was towed with a 1/16 inch 1x19 swaged strand at 7,000 to 8,000 feet tow lengths, at a pressure altitude of 40,000 feet, and an airspeed of Mach 0.75. In both instances, sinusoidal wave oscillations were propagated which resulted in cable failure. An explanation for this phenomena is given in National Advisory Committee for Aeronautics Technical Note Number 1796, "Theoretical Analysis of Oscillations of a Towed Cable," by William H. Phillips, dated January, 1949, and the thesis previously referenced. The Technical Note reported investigation of three pertinent conditions of sinusoidal wave motion in a towed cable. It was found that if the wave velocity is equal to the tow velocity, the wave amplitude remains constant when proceedings down stream from the tow aircraft. If the wave velocity is greater than the tow velocity, the down stream motion is slightly damped. However, when the wave velocity becomes less than the tow velocity, the wave motion is not only undamped, but amplified by the aerodynamic effects acting on the cable. The wave velocity is equal to the square root of the ratio T/μ, with T being the cable tension and μ being the cable mass per unit length. The theoretical cable tension of the two previously mentioned unbalanced conditions was calculated by use of the referenced thesis; in each case, the wave velocity was found to be less than the tow velocity. When this condition is encountered, it may be eliminated by increasing the length of tow and thereby increasing the tension and wave velocity or by reducing the tow velocity.

* * *

Theoretical values for the TDU-9/B target at airspeeds of Mach 1.0 and Mach 1.5 at 40,000 feet pressure altitude are shown in Figures 5 and 6, respectively. The tapered tow wire, which is assumed to be high carbon steel with a constant tensile strength of 312,000 pounds per square inch, has a minimum diameter of 0.043 inch and tapers of 0.076 inch at 40,000 feet. The configuration and tensile strengths of the Stepped I and Stepped II tow members were discussed above.

* * *

The theoretical drag values for the more sophisticated (and substantially larger and heavier) TDU-9/B target at a pressure altitude of 40,000 feet show that the target drag alone at Mach 1.0 and Mach 1.5 is about 308 and 342 pounds, respectively. If a tapered tow wire is used at the Mach 1.5 airspeed, a substantial reduction in system drag can be achieved when



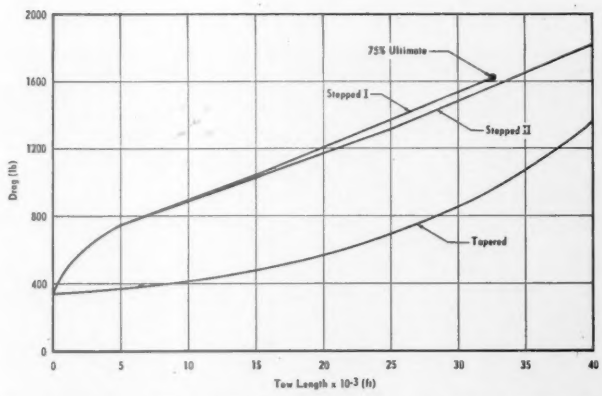


Fig. 6 (Above): Theoretical Tow System Drag for TDU-9/B Target at 40,000 Ft Pressure Altitude and Mach 1.5 * * * * *

Fig. 5 (At left): Theoretical Tow System Drag for TDU-9/B Target at 40,000 Ft Pressure Altitude and Mach 1.0 * * *

compared to either of the stepped configurations. The system drag difference for the three members at Mach 1.0 is much less pronounced. No theoretical values for a constant diameter member have been included because the drag and resultant possible tow member scope would not be acceptable at supersonic speeds. Furthermore, it is anticipated that an unbalanced target-tow member condition would exist, similar to that experienced with the MC-3 target at subsonic speeds. The drag of the first 5,000 feet of the constant diameter strand attached to the target at Mach 1.0 and Mach 1.5 is exceedingly high. It is particularly significant that, even though the stepped aerial tow strand is acceptable, a substantially superior tow cable could be obtained by reducing the drag of the first 5,000 feet of the stepped member. It is evident that this could be effected by utilization of additional steps which would, in effect, approach a taper.

* * *

Appropriate considerations must be given not only to the tensile strength of the wire but to its ability to withstand fatigue under load. The diameter of the storage reel drum and the diameter of the pulleys required to effect directional changes of the wire and strand have a direct effect on tow member life. For instance, if 0.040 inch diameter music wire is loaded to 340 pounds (85 percent of ultimate) and cycled over pulleys having root diameters of 1.25, 1.50, 2.52, and 3.00 inches, failure may be expected to occur after about six cycles. However, if the root diameter is increased to 4.375 inches, cycles to failure should exceed 100. In the event the load is decreased to 300 pounds (75 percent of ultimate), failure of the wire on a three-inch root diameter pulley may be expected after about 85 to 90 cycles. It is evident that subjecting tow wire to loads up to 85 percent of ultimate tensile strength in order to achieve required tow lengths will result in premature wire and strand failures. In order to ensure an acceptable degree of reliability, every effort is being made not to subject wire and strand to loads beyond the yield point which is expected to be about 67 percent of the ultimate. However, some mission requirements may necessitate that the tow members be subjected to loads of about 75 percent of ultimate tensile strength.

* * *

At the present time, it appears that tow system reliability can be increased by utilization of a stepped tow member inasmuch as a tapered wire has not been produced and tested. In the event a sufficient number of steps are made, the results of a stepped strand should be highly satisfactory and should approach the drag values expected for a tapered member. The utilization of the stepped tow members should permit reduction of system loads to an acceptable level. Consideration must be given to strand versus wire for the smaller stepped tow members. The load requirements and fatigue properties are of paramount importance. It would appear that the strand has an advantage over a single wire of equivalent breaking strength in that when one wire of a strand is not capable of developing minimum tensile strength, the remaining wires would probably carry the load, whereas such a similar defect in a single member subjected to the same load as the strand would result in failure.

* * *

The weight and method of installation of a tow system are also important factors. Any weight which can be eliminated will permit the aircraft to attain greater altitudes and airspeeds, with resultant extension of flying time without refueling. Similarly, external installation of tow equipment may reduce aircraft performance to an unacceptable degree. Therefore, all tow equipment should be installed internally in the aircraft. The available space in the Century series aircraft, particularly the F-101A, F-101B, F-102, F-104, F-105, and F-106, is limited. This necessitates utlilization of the smallest tow reels possible which will accommodate required tow member lengths and have required power to reel in tow member and target at optimum airspeeds. The design criteria for tow reels should include provision for a power unit of smallest volume and lightest weight compatible

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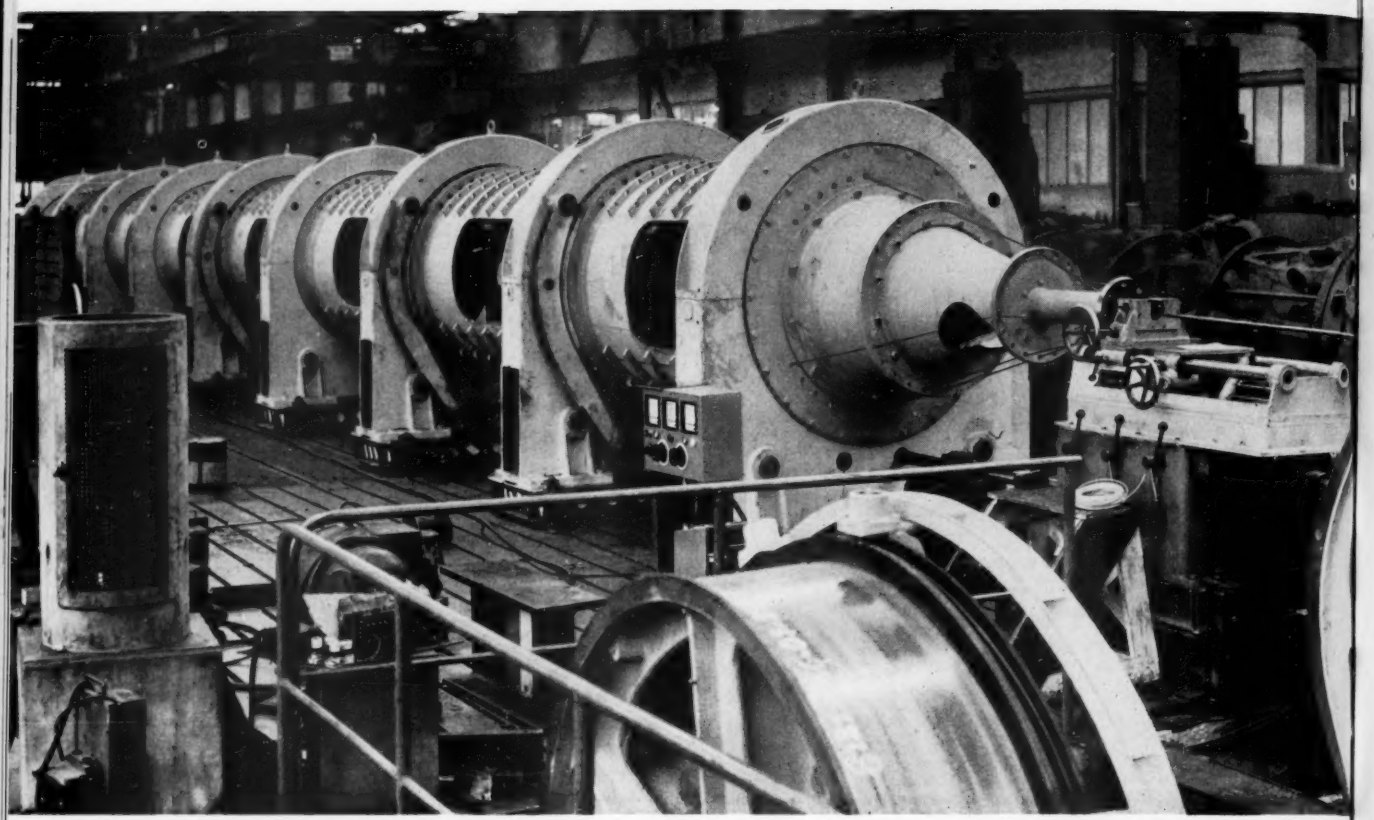

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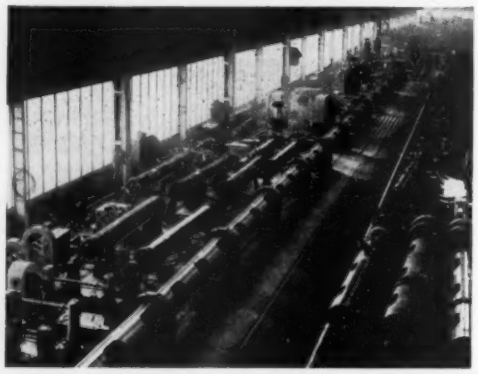

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Some Age Hardenable Copper Base Alloys For Wire Products

by Donald E. Pardon
Design & Development Engineer
Chase Brass & Copper Company
Waterbury, Connecticut

The desire to be able to harden copper by heat treatment has fired the imagination of people through the ages and we still hear references to the lost art of hardening copper, supposedly possessed by some ancient culture. To the best of our knowledge, the ancient coppersmiths were limited to cold work, such as hammering to harden their wares, and it has remained to modern metallurgy to discover how to make copper alloys which can be hardened by heat treatment. Such alloys are the age-hardening or precipitation-hardening alloys which we will cover in part in this paper.

* * *

Neither the term age-hardening nor precipitation-hardening ideally describe the mechanism which takes place in this type of hardening, but both terms are commonly applied. These alloys will not harden completely enough with increasing age alone, nor is it sufficient only to have the precipitation of a second phase in a structure to obtain the type of hardening with which we are concerned. In order to achieve the desired result, we must disturb the basic order of a metal structure. A metal crystal is built like a brick wall with layer upon layer of atoms bonded together by electrical forces shared by neighboring atoms. Unlike a brick wall, the electrical mortar which binds the atoms together, is not as unyielding as concrete. It is relatively easy in a metallic structure to slide one layer over another layer. This sliding or slip is responsible for the ductility of a metal as opposed to the solidness of a brick wall.

* * *

By cold working this structure we can upset the regularity of this arrangement and create what are in effect notches, or dislocations, in the pattern which prevent easy movement of one layer over another. Thus the metal has been hardened because we have limited the amount of slip which can take place with facility. This is the result which we wish to accomplish through age hardening. To do this, we must produce something in the structure which will duplicate the disorganizing or tilting, if you will, of the atomic planes of the metal crystal. This may be accomplished by scattering units of the wrong size throughout the metal structure so that they will cause the desired tipping and dislocation of the structure to give the hardening. We can obtain this result by distributing a second phase or compound with a different unit size throughout the parent matrix or mass. We must start with an alloy which is made up of two phases, one of which exists only in small amounts compared to the other, and has a slowly diminishing solid solubility with decreasing temperature under equilibrium conditions, shown by Line G-B in Figure A.

Donald E. Pardon

The author joined this company in 1950 as Metallurgical Assistant — Products Control at the Chase Metal Works. In 1957 he was assigned to the company's sales department as Rod & Wire Specialist, advancing to Assistant Product Manager of those lines shortly thereafter. Mr. Pardon was appointed to the Product Development soon after its formation in 1959. He is a graduate of Rensselaer Polytechnic Institute and has a Bachelor's degree in Metallurgical Engineering.

This paper was prepared for presentation at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 14, 1959.

* * *

Solid solubility is a perfectly descriptive term since it refers to the solution of metal atoms into a metal solvent structure while both are in the solid state. At the atomic level "solid" matter is composed of a good deal of open space and with the addition of some thermal energy one metal phase can readily dissolve into another like so much salt in water up to its limit of solubility. Figure A is a phase diagram which maps out the solubility of chromium in copper. It represents the solution of chromium and copper and Line G-B represents the limit of solubility under equilibrium conditions.

* * *

The minority phase will have to go into solution in the parent structure so that we can distribute it finely enough to do us any good. This phase, Cr in the diagram, can be taken into solution by raising the temperature along Line S-T until the second phase dissolves in the matrix. It can be kept in solution if the metal is rapidly chilled from this solution annealing temperature so fast that the second phase cannot be rejected. It is held disassociated in the structure in a way that nature did not intend since this is not what is referred to as an equilibrium condition. An additional amount of energy must now be provided to the second phase in order for it to come out of the parent matrix at a reason-

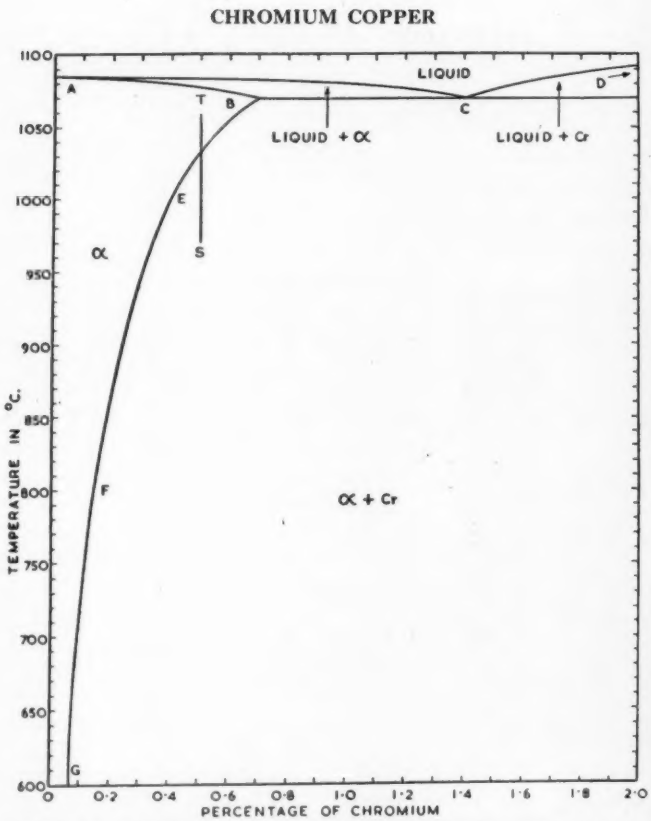


Figure A—(M. Hansen. Aufbau der Zweistofflegierungen, 1936. W. R. Hibbard, F. D. Rossi, H. J. Clark and R. I. O'Herron. Trans. Amer. Inst. Min. Met. Eng., 1948, 175, 283. High Conductivity Copper Alloys, Copper Development Association, 1956, No. 51, 12.)

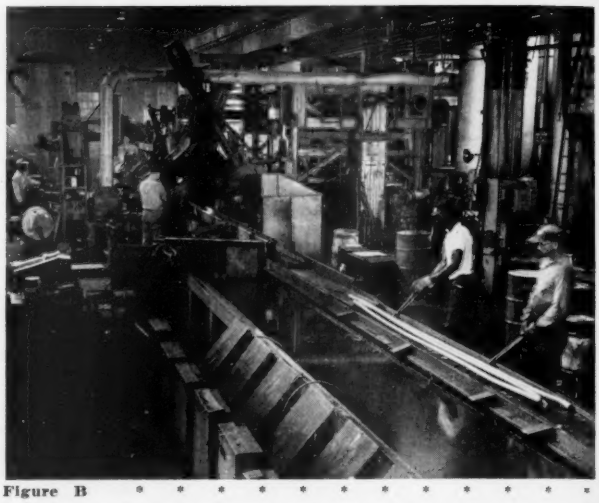


Figure B

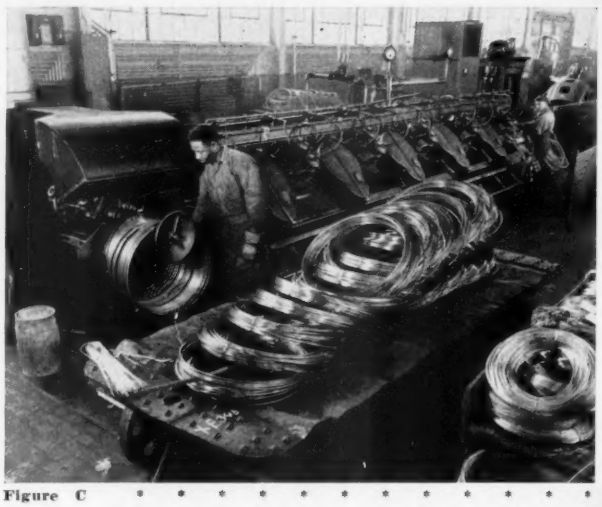


Figure C

able rate. We can provide this energy by heating the metal to a sufficient temperature to accelerate the action which can be continued by holding it at this temperature until the precipitation is sufficiently complete. This is in essence the age-hardening process and it is performed so as to precipitate the second phase as widely distributed as possible, to cause as much dislocation of the structure as possible. The most effective precipitation is submicroscopic and it is only when the material has been over aged or when much more than enough of the precipitate is available that we can see microscopically the actual second phase in the structure.

* * *

About 216 copper rich alloy systems have been discovered which will respond to age hardening. Only a few of these have found commercial applications. Those fabricated into wire are generally alloys based on the addition of beryllium, together with cobalt or nickel, chromium alone or nickel with phosphorus or silicon.

Although the processing varies from one alloy to another, the basic steps can be illustrated by the procedures used for the nickel silicon and nickel phosphorus alloys fabricated in the Wire Mill of Chase Brass & Copper Co. in Waterbury, Connecticut. The alloying constituents are melted in an Ajax low-frequency induction furnace and cast in a water-cooled billet mold 8″ in diameter x 100″ long, which results in a billet weighing about 1500 pounds. This billet is cut into sections 8″ x 24″ long for extrusion into rod 1.687″ in diameter, Figure B. These rods, which are extruded at temperatures higher than the solution annealing temperature for the material, are immediately quenched in a water tank after extrusion. This results in a very satisfactory solution anneal and gives the rod a high workability. As a check for quality of the extrusion operation and also on the soundness of the casting, both the front and back ends of this extruded rod are sheared and examined for defects. These 1.687″ diameter rods are next rod rolled on a 3-Hi Rod Rolling Mill to 0.750″ nominal rod roll shape. From this rod rolling operation, the material is put on a 10-stand Tandem Rolling Mill, Figure C, and reduced to a rounded corner square wire 0.340″ or 0.250″ in thickness, depending on the finished size of the wire to be made.

* * *

Intermediate anneals are used where they are required to remove the work hardening effects of the breaking-down operations. Because of the very high ductility of these alloys before they have been age hardened, a minimum number of intermediate anneals are required. For small diameter wire, the

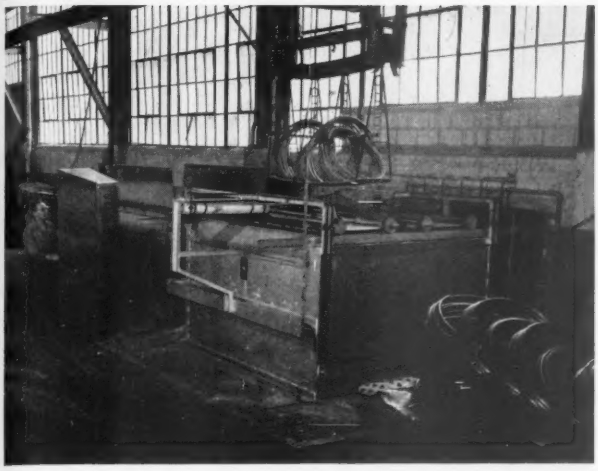


Figure D

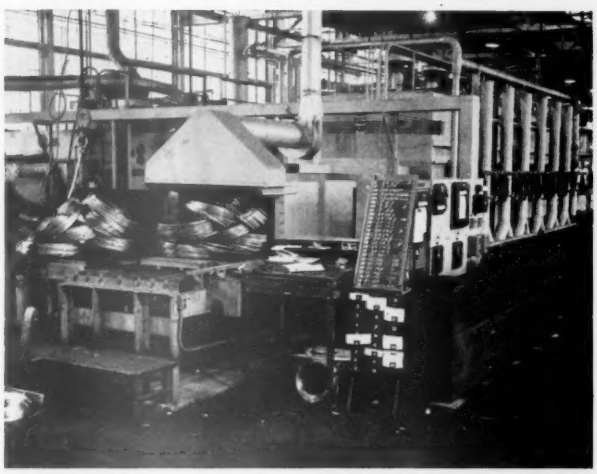


Figure E

square wire is rounded in a drawing die and further reduced to the temper-draw size where the material will be subsequently annealed and quenched prior to the final draws. Larger sizes of wire may be solution annealed and quenched from the rod rolling operation or one of the sizes coming from the 10-stand Tandem Roll. This solution anneal is performed in a neutral salt bath, Figure D, in order that the material be protected from oxidation and scaling during this relatively high temperature treatment. After a suitable soak in the salt bath, the wire is transferred to a water quench tank to retain the second phase in solid solution.

* * *

Some alloys, such as the copper-nickel-phosphorus alloy, are aged immediately following the solution anneal and quench on the temper draw size. Following this age-hardening treatment, the material is finish drawn to hard, spring or special spring tempers. This procedure is followed when the increase in properties of the alloy from age hardening after cold work is not as great as can be obtained by cold working subsequent to age hardening. Prior to age hardening, slugs with a length 1½ times the diameter are flattened to 20% of the original thickness and examined for any surface defects.

* * *

The copper-nickel-silicon alloy is cold drawn following the solution anneal and quench and aged on the finished size in an atmosphere furnace which protects the material from oxidizing during this two-hour anneal at 850° F, Figure E.

* * *

Both the copper-nickel-phosphorus and copper-nickel-silicon alloys are also furnished in the cold forming temper which omits the final age-hardening treatment as a mill operation. Material supplied in this form will be age hardened by the wire fabricator after performing cold heading or severe wire forming operations on the wire.

* * *

In general, the conductivity of age-hardenable alloys is high compared to other high strength alloys of the non-heat treatable type. Conductivities ranging from 22% to 80% IACS are available. High strength bronzes which depend upon simple alloying and cold work alone to develop their strength are generally limited to conductivities ranging between 5% and 15% IACS.

* * *

Since the age-hardenable copper alloys are inherently high copper content alloys, they have the high degree of corrosion resistance which is normal for such alloys. This age-hardenable, copper-rich alloy family then is characterized by high strength, high corrosion resistance, relatively high conductivity and an ease of fabricating such as is generally associated with materials of much lesser strength. Some typical properties of these alloys are summarized in Tables I through IV. Beryllium copper wire is generally available in alloys 10 and 25, the compositions of which are listed in Table I. Alloy 10 is a higher conductivity alloy, while alloy 25 is a higher strength alloy. In wire form, chromium copper, Table II, and copper-nickel-phosphorus, Table III, are usually drawn after age hardening. With such a processing schedule, a greater latitude of tempers is available but the ductility of the wire in the more highly cold worked tempers is somewhat limited. Copper-nickel-silicon is furnished either in the hard temper which has been fully heat treated, or in the cold forming temper which has not yet been aged.

* * *

Depending on the alloy and final properties required, there are two basic methods of manufacture of age-hardening copper alloys. They are the quenched, aged and drawn, or quenched, drawn and aged procedures. In this terminology, we omit the reference to the solution anneal which necessarily precedes the quench, as a matter of convenience. The QAD temper or the QDA temper is treated like a conventional work hardening alloy of similar properties when fabricating items from it. Springs, electrical contacts, nails and like items of age-hardening alloys are made from wire commonly processed in this fashion, provided that any forming required is not too severe. In cases where the degree of cold forming or upsetting necessary to make the final part is too severe to be made from the QAD or the QDA wire, it can be formed from the quenched and drawn temper prior to aging. If the properties required of the final part are moderate

TABLE I

Typical Properties

Beryllium Copper Wire

	Solution Annealed		Heat Treated	
	As Annealed	3/4 Hard	From Sol. Anneal	From 3/4 Hard
Alloy 10 Beryllium, 0.5% Cobalt, 2.50% Copper, Balance				
Tensile Strength, psi	48,000	78,000	100,000	120,000
0.2% Offset Yield Strength, psi			80,000	110,000
Elongation, % in 2"	35	20	10	7
Electrical Conductivity, % IACS			54	54
Alloy 25 Beryllium, 2.0% Cobalt or Nickel, 0.35% Copper, Balance				
Tensile Strength, psi	68,000	125,000	172,000	200,000
0.2% Offset Yield Strength, psi			140,000	172,000
Elongation, % in 2"	42	3	3.5	2
Electrical Conductivity, % IACS			26	26

TABLE II

Typical Properties

Chromium Copper Wire
0.8 Chromium Balance, Copper

	Solution Annealed	Heat Treated From Solution Anneal	Heat Treated & Drawn 25%	Heat Treated & Drawn 75%
Tensile Strength, psi	34,000	58,000	75,000	86,000
0.2% Offset Yield Strength, psi	8,000	38,000	70,000	76,000
Elongation, % in 2"	50	22	16	12
Electrical Conductivity, % IACS	45	80		76

TABLE III

Typical Properties

Copper - Nickel - Phosphorus Wire

1.1% Nickel, 0.25% Phosphorus - Balance, Copper

	Solution Annealed		Heat Treated		Heat Treated and Drawn		
	As Annealed	Hard	From Sol. Anneal	From Hard	Hard, 60%	Spring, 84%	Special Spring, 94%
Tensile Strength, psi	38,000	77,000	65,000	92,000	97,000	110,000	120,000
0.2% Offset Yield Strength, psi	10,000	69,000	45,000	80,000	85,000	97,000	105,000
Elongation, % in 2"	40	3	20	5	5	4	3
Electrical Conductivity, % IACS	32		60	60	59	55	50

Table IV

Typical Properties

Copper-Nickel - Silicon Wire

1.9% Nickel, 0.6% Silicon
Balance, Copper

	Hard	
	Cold Forming Sol. Annealed & Drawn	Heat Treated after Sol. Anneal and Draw
Tensile Strength, psi	65,000	115,000
0.2% Offset Yield Strength, psi	60,000	100,000
Elongation, % in 2"	15	10
Electrical Conductivity, % IACS	20	36

enough and the forming or upsetting required is extremely severe, the solution annealed and quenched temper without any subsequent draw can be used for fabrication and age hardened. In general, age-hardening alloys respond to the aging treatment more satisfactorily after cold work than prior to cold work and, therefore, it is better to fabricate parts from the quenched and drawn temper rather than the quenched only temper prior to age hardening.

* * *

The ability to be formed in the very ductile condition which exists before age hardening is one of the major advantages of the age-hardenable material. Headed items, for instance, which have high strength requirements, but which also require very complicated cold upsets or very sharp bends can be fabricated in this cold forming temper prior to age hardening. Alloys which can only be hardened through cold work must, of course, be fabricated from material which is as hard as the final properties require, with the exception that some slight increase in hardness can be realized by cold extrusion and upset in cold forming. The ductility of such a material can be severely limited by the requirements of the final properties.

As a hypothetical case, let us consider the part shown in Figure F as a part of some electrical equipment which must operate in a fairly corrosive atmosphere at 200° F., maintaining good spring properties and electrical conductivity. Such a combination of properties is available with an age-hardening copper base alloy as well as some copper base alloys which are of the regular cold working type. We will see,

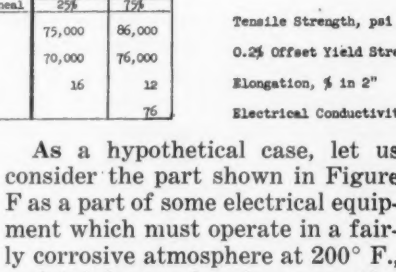


Figure F * * * * * * * * *

however, that this hypothetical part requires a very severe upset on one end with some coined depressions in the upset portion. It also requires a 180-degree bend flat upon itself as well as spiral coiling and a 90-degree bend. If we were to make this part from a conventional cold working material, its temper or springiness would be limited by the 180-degree closed bend, and in all likelihood we would have to make the large upset end as a separate piece to be fastened to the end. A part such as this is well suited to an age-hardening alloy, since it can be completely fabricated from the quenched and drawn temper, which is quite malleable, and after fabrication it can be age hardened to the required spring properties.

* * *

A comparison of the useful strength obtainable in a finished product fabricated from a conventional, non-age hardenable alloy and an age hardenable alloy is shown in Table V. The non-age hardenable alloy is Type B Silicon Bronze, and standard bolts fabricated from it are compared to the same type fabricated from a copper-1.9% nickel-0.6% silicon alloy, age hardened after fabrication. The

TABLE V

Proof Load

Hexagonal Head Bolts, Cold Headed & Roll Threaded

Bolt Size, in.	Average Proof Load, Lbs. Silicon Bronze, Type B	Copper-Nickel-Silicon
1/4 - 20 x 4	980	1,900
7/16 - 14 x 4	3,800	6,800
1/2 - 13 x 4	4,500	9,000
5/8 - 11 x 4	6,000	13,700
3/4 - 10 x 4	8,900	18,500

(*Please turn to page* 1412)

A New Method for the Fatigue Tests on Steel Wires and Wire Ropes and the New Viewpoints Opened by the Results Obtained

by Denis G. van de Moortel
Technical Chief Manager
Wire Ropes Division
United Ropeworks
Leiden, Holland

Though it may be regarded as generally known nowadays, it is perhaps useful at the beginning of this article to point out once again that a wire rope will only give the most satisfactory performance when the following characteristics are completely tuned to its working conditions:

a. *of the steel wire:*
—grade and quality, such as: chemical structure, purity and the processing in the steel plant and in the wire drawing plant.

b. *of the wire rope:*
—diameter of the rope and of the wires.
—construction and lay.
—type of core, coating and grease.

* * *

The following example illustrates clearly that the demands made upon the wire and the construction of the rope can be rather contradictory.

* * *

During the unloading of a ship, the holding line of a clamshell-crane will be subjected to:

a. Fatigue by torsion, by bending on drums and sheaves — which often are rather small in order to save material and power—and by jerky loading.
b. a normal wear in the grooves of the sheaves, but also
c. an extraordinary wear and deformation by pressure, when the rope grates under strain along the edges of the deck, while the clamshell gathers the materials from the far corners of the hold.

* * *

The diameter of drums and sheaves under "a" call for the use of a very flexible rope with relatively thin wires. The circumstances under "c", however, demand a rope construction with a small total number of wires, with the outer layer of the strands consisting of wires of large diameter.

* * *

In this case a compromise will have to be found between the resistance to fatigue, to abrasion, and to deformation. This can be reached by using a rather flexible rope construction of which the outer wires — due to both their steel-quality and diameter — have a high resistance to abrasion, without, however, coming too close to the fatigue-limit or even beyond it. In some cases, the curves of Diagram I can, to some extent, give a lead to a selection; at least as far as the construction of the rope is concerned.

* * *

The factors that can influence the life-span of a wire rope are generally well-known, such as: fatigue, abrasion, material- and rope-deformation, corrosion and damage.

* * *

Denis G. van de Moortel

The author secured his technical education at a Belgian university, began his professional career at a Belgian wire rope mill, and graduated later on at the Polytechnical Institute. He has been district manager of another wire rope factory, and worked in wire mills, specializing in research on steel wire and wire ropes.

In 1950 he joined the United Ropeworks at Leiderdorp (Holland) as Chief Engineer — Technical Manager and developed that mill into one of the biggest and most modern of the Continent.

This paper was presented at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

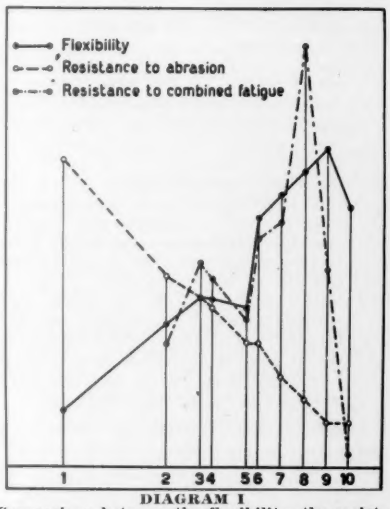


DIAGRAM I
Comparison between the flexibility, the resistance to fatigue and to abrasion of ropes in different constructions.

1. 6x7	6. 6x31 Seale-Warr.
2. 6x19 Seale	7. 6x36 Seale-Warr.
3. 6x26 Seale-Warr.	8. 6x41 Seale-Warr.
4. 6x19 Warrington	9. 6x52 Seale-Warr.
5. 6x25 Filler Wire	10. 6x37

The sequence of importance of these factors varies from one installation to another and is sometimes hard to determine. The preceding example has illustrated this clearly.

* * *

The degree of deformation mainly depends upon the way in which the rope has to work. The corrosion, caused by the effects of the surroundings in which the rope is used, can — to some extent and for some time — be prevented by certain precautions.

* * *

Damage to the rope must be regarded as accidental.

* * *

Only the FATIGUE and the ABRASION of the wire rope can consequently be regarded as being inherent to the installation on which the rope works under normal circumstances. Accordingly they are the factors on which the wire rope manufacturer has to concentrate his attention in the first place.

* * *

Some research institutes have therefore tried to find a way of

testing rope where the influence of fatigue and abrasion prevails.

* * *

The customary way of testing the wire and the rope was naturally insufficient for this purpose and not at all determinent:

—**the tensile test on the wires makes it possible to calculate a sufficiently accurate breaking strength of the rope. It also gives a rough idea about the homogeneity of the raw material. This can as well be concluded more or less from the knotting-, bending- and torsion-tests, which serve at the same time to define the toughness of the wire.**

—**the elongation and the striction can give insight into the quality of the wire, just as**

—**the chemical analysis**

—**the metallographical investigation, that can- to a trained and experienced metallurgist—give many indications concerning the qualities and defects of the wire.**

—**the impact test, the pressure- and elongation-test, according to the method of HAIGH-ROBERTSON, the pulsation test a.s.o. are applied now and then, but in practice they never lead to useful conclusions.**

Some of the mentioned tests can indeed give an idea about the quality of the wire with reference to a certain requirement, but as long as they are applied separately, none of them allows a positive prediction about the way a rope will behave under most normal working conditions.

* * *

In practice — also as a consequence of the rope-fabrication — a combination of simultaneous influences will always lead to a different result.

* * *

It has to be admitted that when a rope — and consequently also the wires comprising it — is subjected to fatigue (by bending as well as by torsion and pulsation) and to abrasion; the resultant of all these influences must give an outcome, which differs from the results of all the separate tests on torsion, bending, abrasion, or pulsation.

* * *

This remark goes for the so-called fatigue test as well, where the wire rope runs to and fro over sheaves, but on such a short stretch, that no torsion and changing tension can take place.

* * *

Therefore it has to be understood, that the results of this bending-fatigue test lead to conclusions, very often found to be of little worth in practice.

Yet this test is still often used, but the wire grade or rope construction advised with reference to the outcome of this so-called fatigue test hardly ever gives satisfactory results.

* * *

Incidentally it may be noted that for the mentioned example of the clamshell rope, the bending-fatigue-test could not possibly have furnished a reasonable compromise.

* * *

Taking into account the demands made upon the wire rope and the short-comings of the testing-methods summed up above, I came to designing a machine on which a wire rope — and therefore the composing wires as well — are simultaneously subjected to almost all the influences found in practice. Thus the reality is much better imitated.

* * *

On this machine, of which Fig. 1 and Fig. 2 show the working-principle, the rope — or the strand, when heavy wires have to be tested — is during a single to-and-fro-movement (one fatigue-cycle) simultaneously subjected to:

—**alternative bendings**

—**alternative torsion, with twisting and untwisting of the rope and (or) strand.**

—**abrasive wear**

—**changing, regulable and slightly jerky tensions.**

—**resonance (while testing certain kinds of wire, vibrations caused a broken wire in a part of the testpiece, that was neither bent nor twisted). (Fig. 3)**

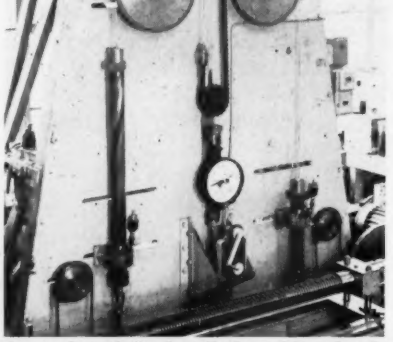


Fig. 1—One of the described machines for the combined fatigue test. * * * * *

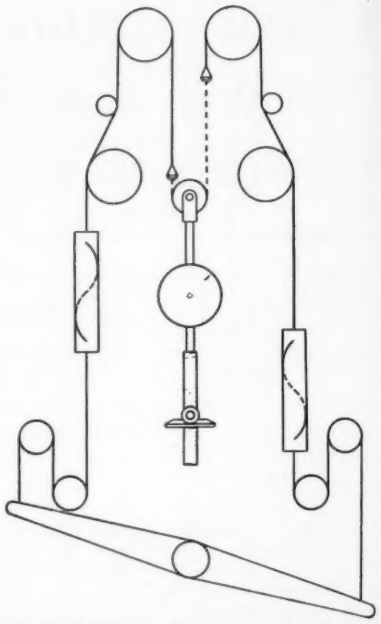


Fig. 2—Schematic drawing of the machine.

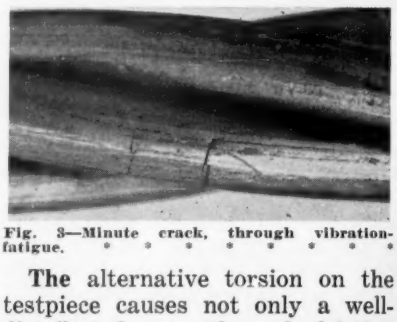


Fig. 3—Minute crack, through vibration-fatigue. * * * * * * * *

The alternative torsion on the testpiece causes not only a well-distributed wear through friction in the sheave-grooves (Fig. 4), but also friction between the strands or between the wires during the twisting and untwisting. (Fig. 5-6) The influence of the wire coating, of the type, the density, and the lubrication of the core in the wire rope can equally well be thoroughly determined.

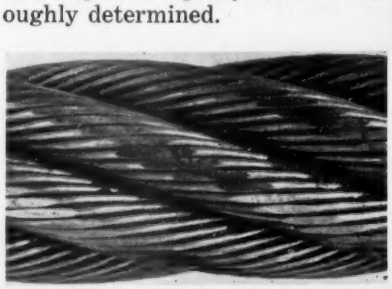


Fig. 4—Well-distributed wear through friction in the sheave-grooves. * * * *

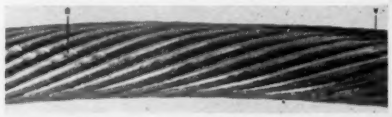


Fig. 5—Wear (A) and indentations between the strands (B) * * * * * *

Fig. 6—Broken wires through fatigue and wear (external and between the strands.)

During the testing of heavy wires (especially for the use in mine shaft ropes and drilling lines) the strand runs in inverse bendings over a pressure sheave or over a fixed sheave in which a ring is imbedded of tungsten-carbide, to accelerate the abrasion.

* * *

The amplitude and the frequency of the vibrations can be influenced by changing the shape of the teeth and the chain-links.

* * *

I apply a slight inverse bending of about 170°, because it aggravates the test somewhat and it allows a better and quicker differentiation in results from the comparative tests on various grades of wire and on various wire rope constructions.

* * *

Because a fatigue test has to be an accelerated test, I take a smaller ratio sheave-diameter to wire-diameter than would be advisable in practice. It varies from 194 to 310. Smaller and larger sheaves can be used and their position in the machine can be adjusted; interchangeable cylinders with different pitch make it possible to alter the torsions. The conditions under which the tests are made can be aggravated or lightened. The tension is regulable as well, which is, by the way, necessary to compensate the loss of tension caused by the stretching of rope or strand.

* * *

While utilizing this fatigue testing machine during the last couple of years, we were able:

* * *

a. **in co-operation with the steelproducer, to develop a superior grade of steel wire, especially for the use in the important mine shaft ropes, we are exporting. Those ropes usually make record-performances. (diameter of the ropes: 2½" — 2¾" and diameter of the wires: .11" — .13", tensile strength up to 136 tons per sq. in.)**

b. **to make up a classification of the various rope constructions that were in use and for those, that we brought on the market because they are more up to date and better adapted to working conditions.**

c. **to make comparative tests on ropes, not only made from different wire grades, but also made from wires, that were zinc-coated in different ways.**

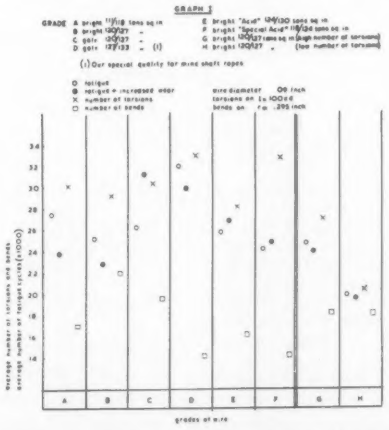
d. **to compare the many kinds of grease, which, moreover, were applied to the testpiece in different ways.**

* * *

Because the results that were obtained with those combined fatigue tests have been confirmed in practice, I think the time has come when some of the rational conclusions have to be revealed to those interested.

I. Tests On Wire

During the tests on wire of different grades and of diameters, varying from .078" to .114", I was once more able to note that it is impossible to predict the resistance to fatigue, judging on the results of the normalized tests on torsion and bending. Graph I proves this clearly. When testing wires from



Graph I—Results of the combined fatigue tests on heavy wires of different grades.

one lot, it showed that the best results were obtained with testpieces, taken from the coils, having the highest resistance to torsion. This would prove that the resistance to fatigue goes hand in hand with the resistance to torsion. When comparing the results of tests on wires from **different** lots, it appeared to be totally different. Sometimes we even found that the lower the amount of torsions, the higher the combined fatigue resistance. This wire evidently had other properties, that did not find expression in the torsion test.

* * *

At the same time it appears from the graph that, as far as the combined fatigue resistance is concerned, the result of the bending test does not give a single indication. It has always surprised me that some official authorities who ought to know quite a lot about steel wire and wire ropes, base their judgement on the quality of the wire — besides, of course, on the tensile strength — solely on the number of bends. They prescribe, for instance, that the wires, whose number of bends do not reach the requirements, may not be taken in account when calculating the aggregate breaking strength of the tested rope!

Graph I also shows plainly:

1. **that wire in "Acid" and "Special Acid" — quality in the least comes up to the requirements that are often made upon it. This has indeed been confirmed by experiments made in coalmines abroad, where they saw no reason anymore in demanding the more expensive and often hard-to-get "Acid"-quality.**
2. **that drawn galvanised wire, even with a high tensile strength, does not have a lower resistance to combined fatigue than uncoated wire. I shall return to this subject later in this article.**

II. Tests On Ropes

The results of the comparative tests I made during the last years are divided according to the normal use of the various constructions, namely in:

GROUP 1:
the 6x19 classification, including the 6x19 in two operations (1+6+12) and all the other, more modern constructions, which have already replaced the out-of-date 6x19.

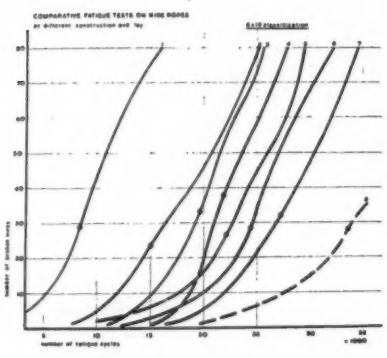
GROUP 2:
the 6x37 classification, including the outdated 6x37 in three operations (1+6+12+18) and all the modern constructions which replace it.

* * *

The results of group 1 are shown in graph II and those of group 2 in graph III.

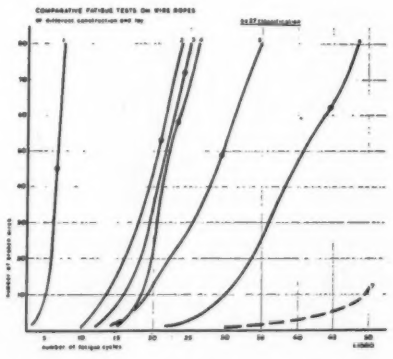
* * *

While studying both graphs, it will be noticed immediately that the ropes in the Seale-Warrington constructions stood up to the fatigue tests much better. On graph II it suffices to compare the curves of the 6x26 and the 6x31 Seale-Warrington with those of 6x21 and 6x25 Filler Wire. Just compare on Graph IV the curves of 6x41 and 6x36 Seale Warrington with the curve of 6x35 (a so-called "covered



Graph II

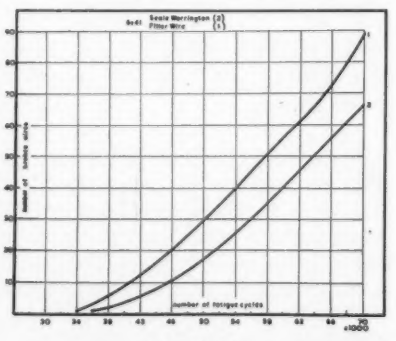
1. 6x19 obsolete
2. 6x19 Seale
3. 6x25 Filler Wire
4. 6x19 Warrington
5. 6x21 Filler Wire
6. 6x26 Seale-Warr.
7. 6x31 Seale-Warr.
8. 6x26 Seale-Warr. Lang-Lay.



Graph III

1. 6x37 obsolete
2. 6x37 half-Seale
3. 6x52 Seale-Warr.
4. 6x35 covered Warr.
5. 6x36 Seale-Warr.
6. 6x41 Seale-Warr.
7. 6x41 Seale-Warr. Lang-Lay.

Seale": 19 wires Warrington covered with a separately twisted outer layer of 16 wires during a second operation). Some foreign manufacturers still advise this 6x35 as being the best construction. Graph IV gives a comparison between 6x41 Seale-Warrington and 6x41 Filler Wire — under altered testing conditions.



Graph IV

The results, mentioned here need, however, a further explanation, namely, as follows:

The condition of the outer wires usually determines the time, when the rope has to be discarded. I never could agree with this method, in the first place, because many other influential factors are not counted in and secondly because the total metallic area of all the **outer** wires varies greatly from one construction to the other and consequently the reserve breaking strength of the remaining **inner** wires as well. Therefore I calculated for each tested construction the amount of broken outer wires, which can be allowed, before the decrease in breaking strength would bring the safety factor below the minimum level. This maximum allowable number of broken wires has been marked in the graphs with a little circle on each of the curves. Table I shows a classification, made up in view of the maximum number of broken wires. The already mentioned difference between some of the constructions is even more pronounced here.

TABLE 1

Construction of the wire rope	*Maximum allowable number of broken wires*	*Reached after n cycles*	*Construction of the wire rope*	*Maximum allowable number of broken wires*	*Reached after n cycles*
Group 1			**Group 2**		
6x19 obsolete	29	8,300	6x37 obsolete	45	6,500
6x19 Seale	24	15,000	6x37 half-Seale	53	21,000
6x25 Filler Wire	33	19,500	6x35 covered Warr.	58	23,000
6x19 Warrington	38	22,000	6x52 Seale-Warr.	72	24,200
6x21 Filler Wire	26	22,100	6x36 Seale-Warr.	49	29,000
6x26 Seale-Warr.	28	24,200	6x41 Seale-Warr.	62	44,000
6x31 Seale-Warr.	32	27,500			
6x26 Seale-Warr. Lang-Lay	28	33,500	6x41 Seale-Warr. Lang-Lay	62	84,000

A careful study of the results, obtained from these comparative tests on combined fatigue has led to the following conclusions, which — I want to underline this here once again — are confirmed in practice:

GROUP 1 6x19 classification

—A rope in 6x31 Seale-Warrington with 12 thin outer wires withstood many more fatigue cycles than a 6x19 Seale rope with only 9 considerably larger wires in the outer layer. This can easily be explained, because the larger wires have a much smaller resistance to bending — and torsion-fatigue, which cannot be compensated by a greater resistance to abrasion. Therefore this 6x19 Seale can only be used, where the rope is mainly subjected to abrasive wear.

—This 6x31 rope also gives better results than the 6x19 (1+6+12) and the 6x25 Filler Wire-construction, in spite of the fact, that all three constructions have the same number of outer wires (12) of the same diameter. This can be attributed to the better construction of the 31-wire strands. They have no wire-crossings as appear in the obsolete 19 (1+6+12)—wire strands and they have no large inner wires with relatively very thin filler wires, as the 25 Filler-Wire strands have. The greater flexibility of the 6x31 allows a better adjustment of the rope on the sheaves.

—It is remarkable that the 6x26 with only 10- and consequently larger outer wires endured a larger number of cycles than the 6x25 Filler Wire. In this 6x26 a satisfactory combination has been found between the resistance to combined fatigue and a raised resistance to abrasion (through the larger outer wires). The greater flexibility of this rope with its thin inner wires (Fig. 7) has naturally contributed to the better results as well. The 6x26 has indeed given a better outcome than the 6x21 Filler Wire. In spite of having 10 outer wires as well, the 6x21 is far less flexible because of the large inner wires; moreover it has very thin filler wires (Fig. 8, A and B)

* * *

In most cases the 6x25 had better be replaced by the 6x26. Only where a high specific pressure has to be expected and deformation of the strands must be feared, it is perhaps better to give preference

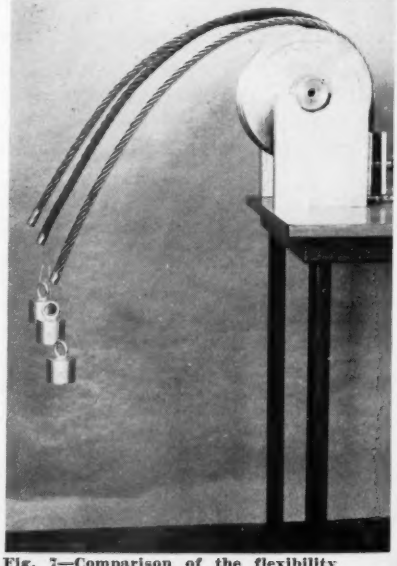


Fig. 7—Comparison of the flexibility
Front: 6x26 Seale-Warrington
Middle: 6x25 Filler Wire
Background: 6x19 (1+6+12)

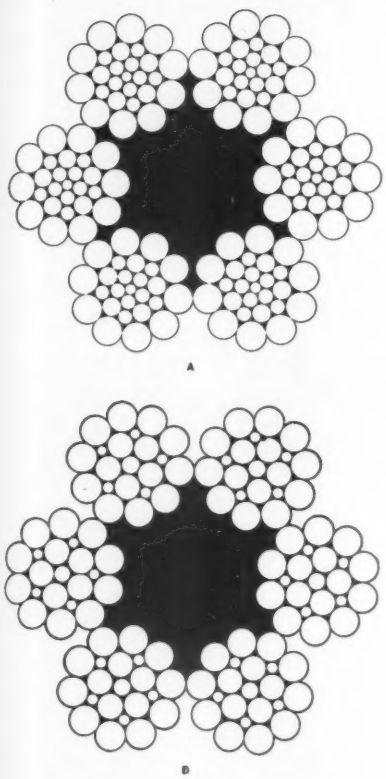


Fig. 8—Cross-section of ropes in the constructions:
6x26 Seale-Warrington (A)
6x21 Filler Wire (B)

to the 6x25, though the resistance to abrasion and flattening of the wires is much less than of the 6x26 with its larger outer wires.

* * *

GROUP 2 6x37 classification

A comparison can be made here:

—between the 6x41 with 16 outer wires and the 6x52 with 18, thinner wires in the outer layer.

—between the 6x36 with 14 outer wires and the 6x37 half-Seale with 15 outer wires.

—between the 6x41 and the 6x35, both with 16 outer wires of the same diameter. The first in Seale-Warrington construction, without any wire-crossings; the second has wire-crossings between the outer layer and the Warrington-layer under it.

—between the 6x41 in Seale-Warrington and the 6x41 Filler Wire.

* * *

A maximum number of fatigue cycles has been reached with the rope in the construction 6x41 Seale-Warrington in which — under identical working conditions — a middle course has been found between the resistance to bending and torsion and the resistance to abrasion.

* * *

In the discussion of both groups I did not mention the obsolete 6x37. The results, obtained while testing this rope, were so far below those of the Seale-Warrington types (in practical life as well), that I am astonished every time to see how many users of wire rope still insist on getting this out-of-date construction. The slightly lower price can not possibly compensate for the by far worse working-performance it gives.

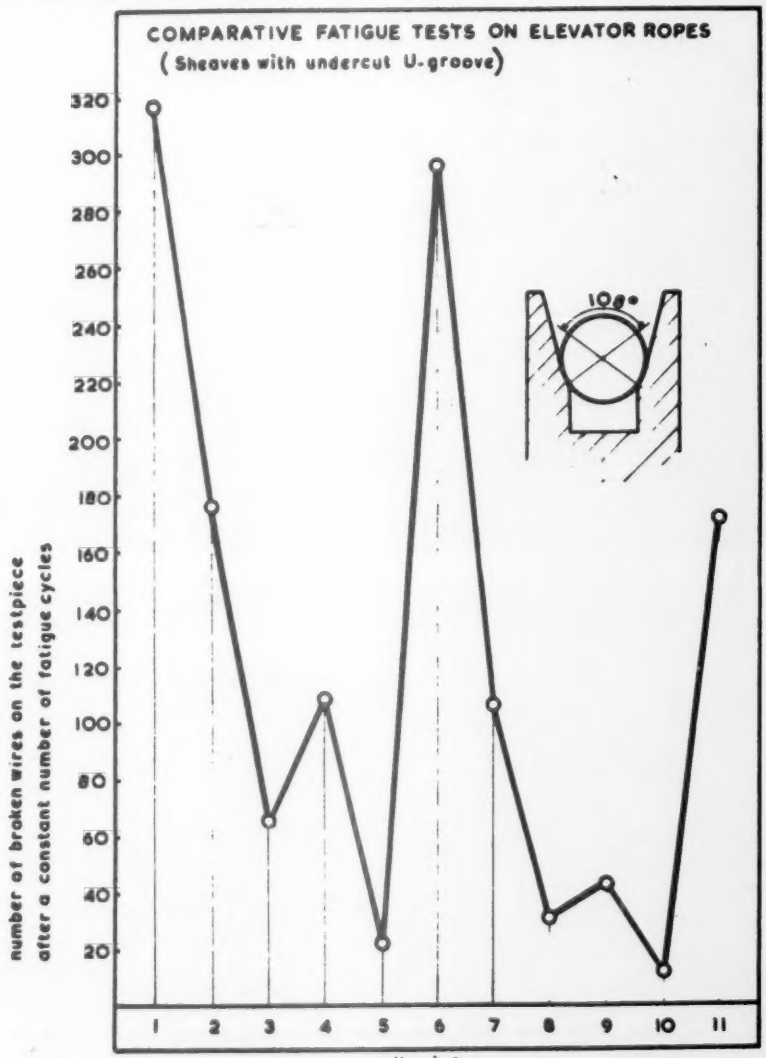
* * *

Although it is generally known, both graphs show clearly once again the superiority of ropes in Lang-Lay. Though it seems that these ropes can only be used on few installations, I think that the field of application can be considerably extended.

* * *

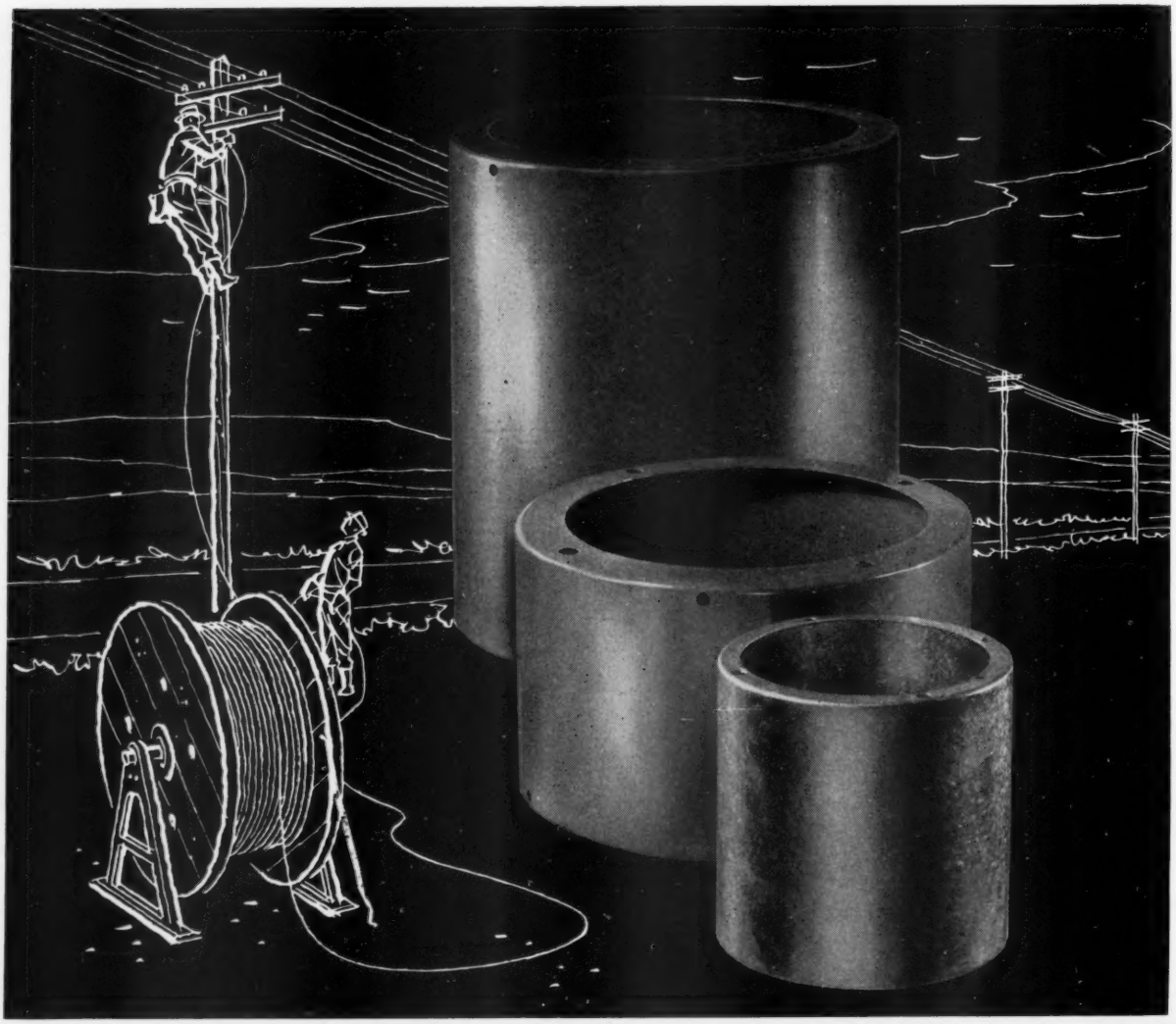
After tests in our laboratory we came to applying with very good results: 1). Lang-Lay ropes on traction elevators (graph V).

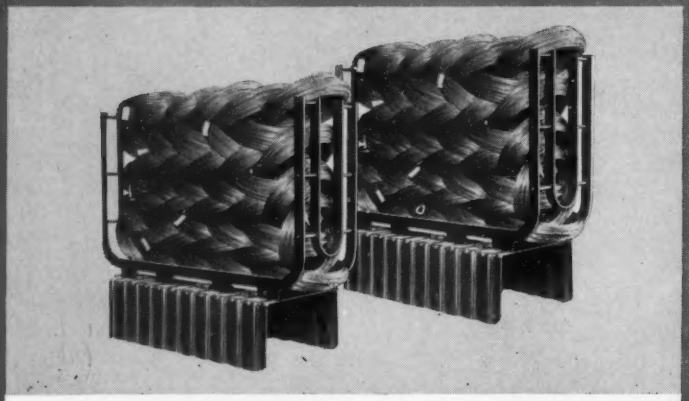
2). Completely non - spinning ropes of 18 strands (6+12) with the outer layer of strands in Lang-Lay. Thus we avoid the crossing of wires between the two layers of strands. Consequently there is no danger of prematurely broken inner wires. This will always be the case in non-spinning ropes in regular lay, where indentations will appear.



Graph V

1. 8x19 Seale, regular lay, bright, 95/102 tons/sq. in.
2. 6x19 Seale, regular lay, bright, 95/102 tons/sq. in.
3. 6x19 Seale, Lang-Lay, bright, 95/102 tons/sq. in.
4. 6x26 Seale-Warr., regular lay, bright, 95/102 tons/sq. in.
5. 6x26 Seale-Warr., Lang-Lay, bright, 95/102 tons/sq. in.
6. 6x25 Filler Wire, regular lay, bright, 82 tons/sq. in.
7. 6x25 Filler Wire, regular lay, bright, 95/102 tons/sq. in.
8. 6x25 Filler Wire, Lang-Lay, bright, 95/102 tons/sq. in.
9. 6x26 Seale-Warr. regular lay, galv., 95/102 tons/sq. in.
10. 6x26 Seale-Warr. Lang-Lay, galv., 95/102 tons/sq. in.
11. 6x19 Seale, regular lay, bright, 89/102 tons/sq. in.





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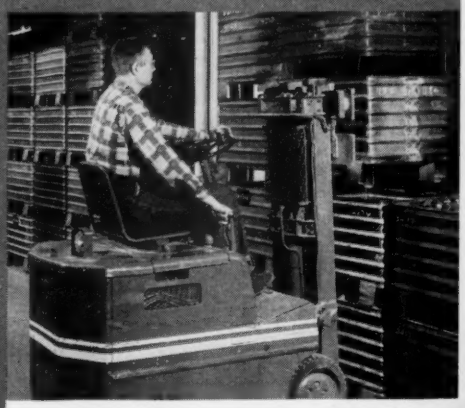

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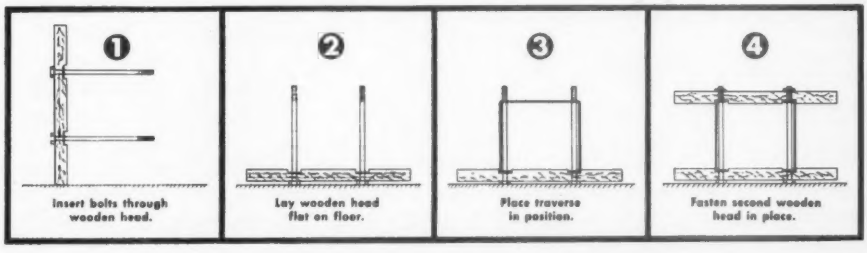

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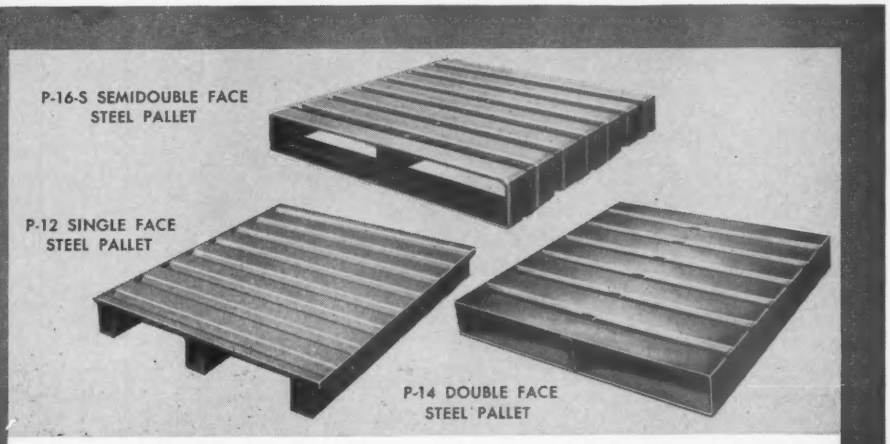

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1. **The** results, shown on graph V (elevator ropes) are self-evident and need no further explanation. Worth noting are the relatively low performances of ropes with 8 strands and the 6x19 in Traction Steel, when compared with our ropes in 6x26. The best outcome was reached, here as well, with ropes in drawn galvanised wire (the difference became even bigger, when the tests were prolonged).

   Most ropes we fabricate for the use on traction-elevators with undercut U-groove are nowadays in the 6x26 construction.

* * *

2. **Most** of the mine shaft ropes we are exporting are of the 18-strands type with 12 outer-layer strands in Lang-Lay. Some are as long as 3900 feet with a 2½" to 2¾" diameter. With those ropes record-performances have been reached.

* * *

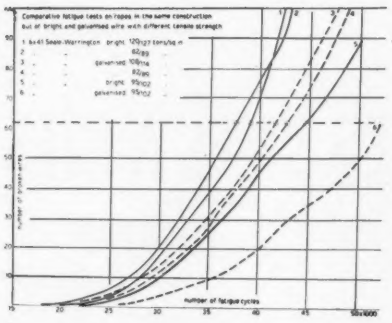
The non-spinning ropes in Lang-Lay (18 strands with 17 or 19 wires in Seale-construction) we are making for single-part cranes are favoured more and more by the users.

The Importance of The Tensile Strength

Graphs II, III and IV have been made up with the help of extensive series of fatigue tests on ropes made of wire with a tensile strength of 95/102 tons/sq.in. (150/160 kgf/mm²).

* * *

Because the experts do not even agree upon the advantages and disadvantages of the various classes of tensile strength, I thought it was necessary to make comparative fatigue tests on ropes made of wire with different tensile strength. And this in bright as well as in galvanised wire. As construction the 6x41 was the most suitable, because former tests had proved, that with this rope the highest number of fatigue cycles had been obtained.



Graph VI

Fatigue tests on 6x41 in different wire grades (bright and galvanised) * * * *

Graph VI shows the curves of the average results we scored. Because these results were confirmed in practice, the following conclusions can be drawn from the survey of Graph VI:

—wire of the lowest tensile strength (82/89 tons/sq. in.) gave the worst results.

—wire with a much higher tensile strength (120/127) gave a far better outcome.

—wire of 95/102 tons/sq. in. has the highest resistance to combined fatigue.

—for the same tensile strength, drawn galvanized quality gave the best results. Graph I and V led to the same conclusion, as well as Graphs VII and VIII, in which the results were gathered of the tests I made on ropes with wires, galvanised by various methods: hot-dipped galvanised, drawn galvanised with different weights of zinc-coating and electro galvanized.

* * *

The better resistance to combined fatigue of drawn galvanised wire is due to:

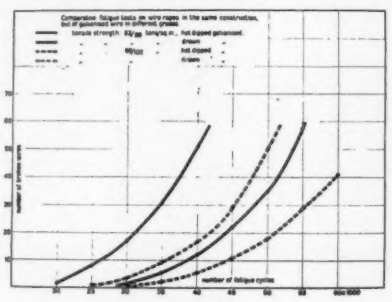
a. the presence of a lubricating layer of zinc that, thanks to the drawing process, is not too soft.

b. the coat of more ductile material that envelops the steel wire and prevents the premature appearance of minute cracks.

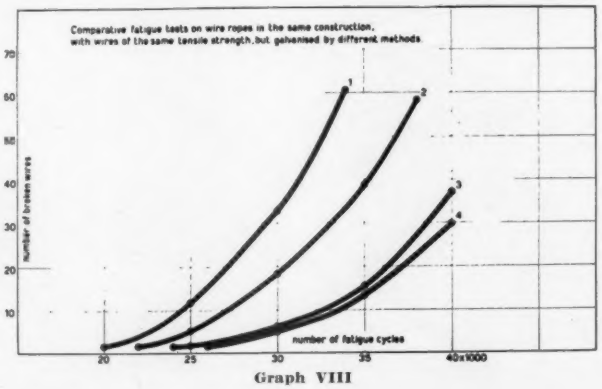
c. the fact that the wire undergoes a rather severe pre-selection, while running through the molten zinc and over the lead-sheaves (especially in the vertical galvanising process), where the wires with the least resistance to aging would have to be rejected. At least when the same demands are made upon galvanised wire as on bright wire (torsions, bends and homogeneity). This is more and more the case with drawn galvanised wire.

* * *

Because the ropes in galvanised wire gave better results than those in bright wire on the combined fatigue testing machine in the laboratory, it will be clear, that this will in all respects be the same in practice, where the ropes are subjected to the influences of the atmosphere and where the resistance to fatigue can be considerably reduced by normal corrosion, stress-corrosion, cracking- and fretting-corrosion.



Graph VII



Graph VIII

Curve:	1	2	3	4
Average tensile strength in tons/sq. in.	105	103	102	102
Average number of torsions on l= 100 xd	28.3	51.1	47.3	47.7
Average number of bends on r= .197"	17.5	18.8	12.7	18.1
Average weight of zinc-coating in ounces/sq. ft.	0.47	0.28	0.48	0.51

In reference to the obtained results, I advise more and more ropes in drawn galvanised wire in place of those in bright wire. Because in every case a better performance was noted, the demands for those ropes increases steadily.

* * *

The importance of the weight of the zinc-coating is once again underlined by the comparative tests, made on ropes in wire with a low weight of the zinc-coating per sq. ft. and those in wire with a much higher weight of zinc per sq. ft. (curves 2 and 3 in Graph VIII).

* * *

The data, noted in Table II, show that both kinds of wire had practically the same mechanical properties. I agree that they do not form a criterion for the resistance to combined fatigue, but in view of the numerous tests, made in this way, it may be concluded, that the better outcome of the ropes in wire of group III can be attributed for the greater part to the presence of a better zinc-coating.

* * *

Probably this is also the reason of the slightly better performance of the rope in electro galvanised wire. It strikes, however, that there is no considerable difference between the results of good drawn galvanised wire and electro galvanised wire. Judging on the often praised quality of the latter, it could be expected to be otherwise.

* * *

During the corrosion tests — immersion in circulating seawater, combined with periodical exposion to the air — to which the different kinds of wire were set out, there appeared a difference in the loss of zinc (see the table below).

Grade	1	2	3	4
weight of the zinc-coating in ounces per sq. ft.	0.54	0.34	0.67	0.65
loss in %	35.8	57.5	39	26.8

* * *

Still I prefer grade 3, because it has a greater resistance to abrasion and erosion and surely because irregular ionisation in the electro galvanising process is unavoidable, resulting in a more or less porous coating (Figs. 9 and 10).

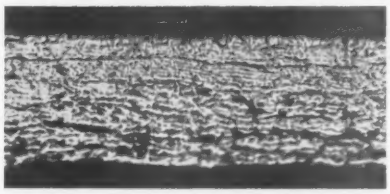


Fig. 9—Microphoto of electro galvanised steel wire

Fig. 10—Microphoto of electro galvanised steel wire

Conclusions

Concerning the advice for the application of wire grades or rope constructions, the results I obtained by the combined fatigue tests according to the new method as described above and the fact that these results were completely confirmed in practice afterwards have often led me to deviate strongly from the since long established conceptions.

* * *

Because the performances of the ropes, advised on account of the latest experiences, were considerably higher than those, formerly achieved on the same installation, I concluded that the fatigue tests I made gave me a far better insight into the adaptation to working-conditions of the wire quality as well as the rope construction, than was possible with the tests formerly made by other methods.

* * *

I would like to be allowed to state that the above described method for combined fatigue tests on wire and rope has surely opened many new perspectives. More than any other so-called fatigue test, my method copies the normal working conditions of a rope as well as possible.

* * *

The construction of the fatigue testing machine allows an altering of the test to copy more special working conditions; the tension, the torsions, the degree of inverse bending, the diameter of the sheaves and also the abrasion can be lightened or aggravated; the form of the sheave-grooves can be altered as well.

* * *

In most cases the test also allows in a minimum of time and with a rather great accuracy a determination of the degree to which a certain wire quality or rope construction will give satisfaction under given circumstances.

* * *

During the described fatigue test a good comparison can be made between the various kinds of grease[1] and cores (fibre, plastic, steel-wire a.s.o.)

* * *

Systematical fatigue tests must lead — in a rather short time — to an increasingly better adjustment of the wire rope quality and consequently to a more satisfactory performance.

* * *

I daresay that the fatigue test, when adjusted to practical life conditions as well as possible — as is the case in the method designed by me — will gradually supplement the usual methods of testing and will even replace them partly.

* * *

The tests I mentioned are only part of the large, and by far not yet finished program, on which I am working. Fortunately I can announce that in the near future other laboratories that have asked permission to build the described fatigue testing machine, will contribute to the program.

* * *

Good co-operation between the steel-producer, the wire and the wire rope manufacturer, the user of the ropes, and the official instances that are charged with the testing of the ropes, will realize many improvements that are in prospect on account of the results already obtained.

---

(1) Together with a newly designed test for the determination of the dripping and sliding temperatures, of the adhesion and the corrosion-prevention, the combined fatigue test allowed us to develop several new kinds of grease, that came up to the highest requirements.

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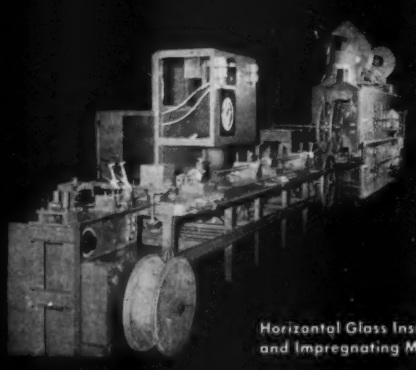

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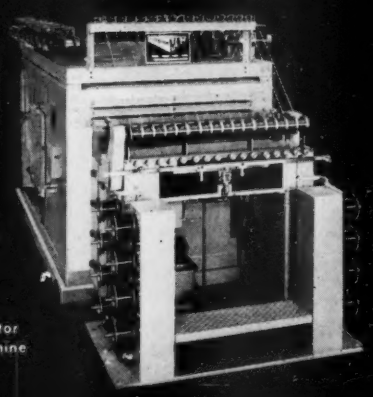
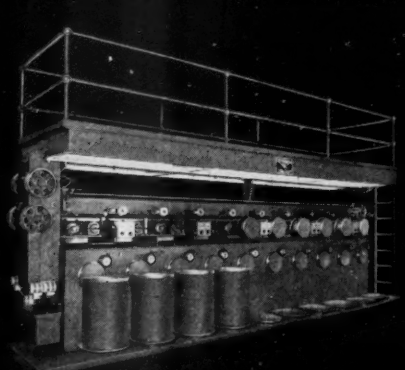


Combination Spooler and Barrel Wire Takeup



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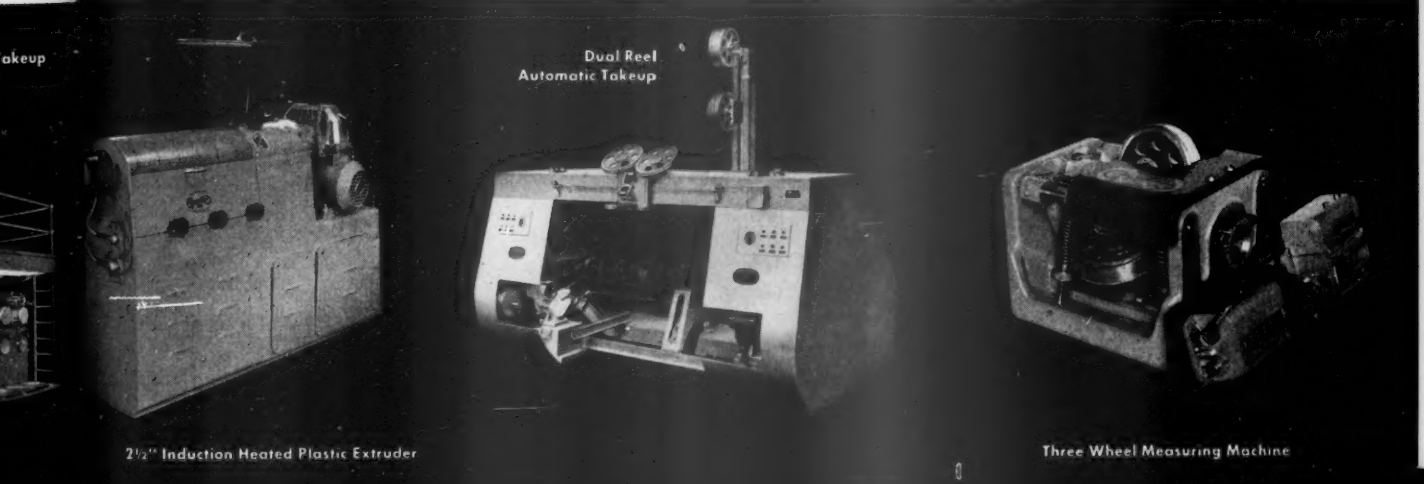

Dual Reel Automatic Takeup

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Three Wheel Measuring Machine

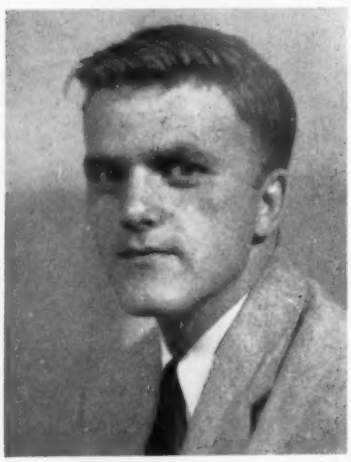
Facilities for Wire Irradiation with an Electron Beam Generator

by R. P. Skundberg
Application Engineer
X-Ray Department
General Electric Company
Milwaukee, Wisconsin

What is an irradiation facility and how does it differ from other machines used in the wire industry? An irradiation facility is an electron beam generator placed in a separate room with the proper conveyance or in part of a building that is shielded by a heavier barrier wall from those areas occupied by plant personnel. In the irradiation room the electron beam generator produces a beam of radiation by electrical means. This beam is absorbed by the plastic insulation on the wire, while it is conveyed into the room and out again after the treatment. The operator's control area and the accessory component room are usually located adjacent to the irradiation room.

* * *

The floor area required by the process is not great. The exact area will depend upon the size of electron beam generator installed and to a large extent on the particular material being handled. The requirements of space for handling equipment, such as reeling and unreeling devices, conveyors, and like equipment, is a factor depending upon the individual operation. As a minimum, a room 10′ x 10′ or 8′ x 12′ might be used as the basic size. The thickness of the shielding walls will add to the floor area as will the space required for auxiliary components and operator's controls. A total floor space of perhaps 500 square feet would be a practical minimum to assign to the irradiation process. Requirements for the height of the installation will vary with the particular electron beam generator installed. Most irradiation of wire can be done with 1 million or 2 million volt equipment. Such equipment ranges in total height from 10′ to 14′ depending upon voltage. Equipment diameters range from 3′ to 4½′. The over-all height for an installation will generally be of the order of twice the total electron beam generator height in order to facilitate the installation and subsequent maintenance of equipment. The total room height may be entirely in the irradiation chamber or more conveniently divided between two separate rooms covering two or more floors of a plant. In such case, the irradiation chamber is separated from the room above which contains the main body of the electron beam generator.



R. P. Skundberg

Following a tour of duty with the U. S. Navy during the Korean conflict, the author attended the Milwaukee School of Engineering and graduated in 1955 with an AAS degree. Since then he has been with the General Electric Company in the X-Ray Department as an Application Engineer, working on the Electron Beam project.

He prepared this paper for presentation at the Annual Convention of The Wire Association in Cleveland on October 13, 1959.

* * *

Typical floor plans for electron beam generators are shown in the appendix. A maze structure gives radiation shielding and still affords easy access to the irradiation room. A subterranean pit can also be used. It is less costly to build since it uses the natural shielding of the earth. The operator's console is usually placed near the entrance to the irradiation room. The other electrical components are placed in an adjacent room. Many alternate arrangements are possible.

* * *

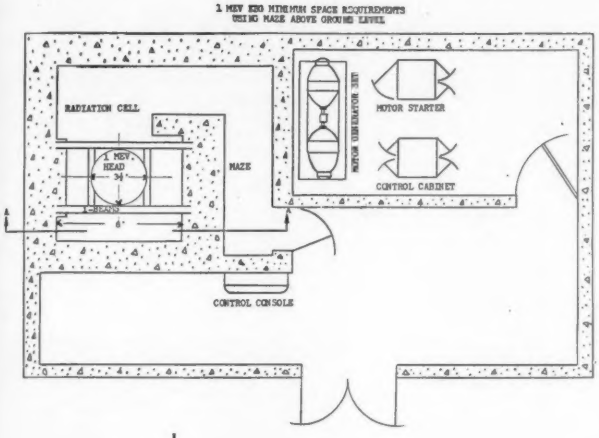
Irradiation shielding is necessary to protect personnel from the radiation produced when the machine is on. When the electron beam generator is turned off the area can be safely entered without any radiation danger. There is no residual radioactivity from the machine or its shielding under normal processing conditions.

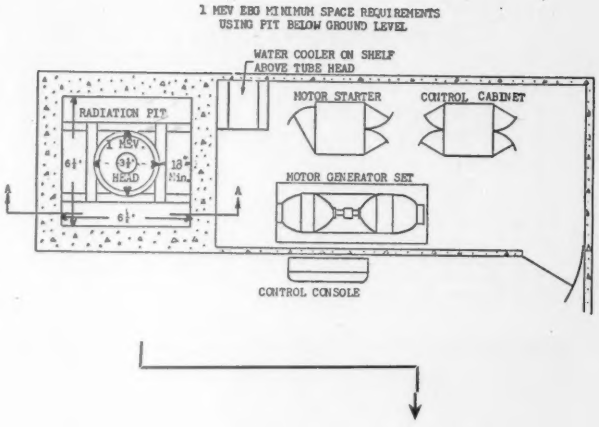
* * *

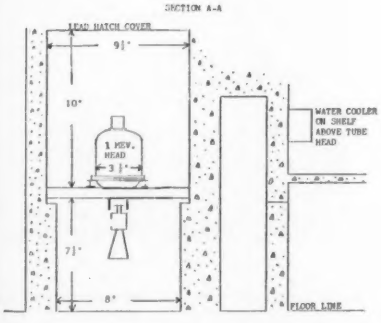
Shielding may be of many materials. Lead and heavy metals are excellent absorbers for radiation, but their cost is high. Similarly concrete mixed with iron ore or heavy mineral aggregates is efficient, but expensive.

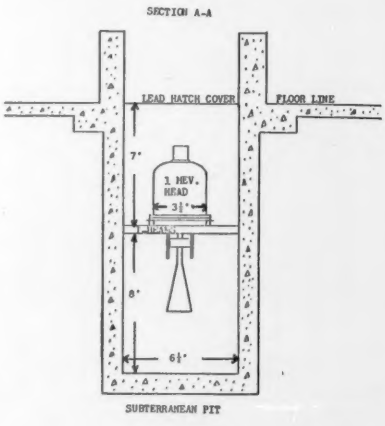
* * *

Consequently, poured walls or precast concrete walls and ceilings or solid concrete block laid into wall form are the most common shielding materials. The concrete thickness required for 1 million volt radiation is 2½′ and 4′ for 2 million volt radiation. These are typical values. Exact thickness will depend upon voltage and kilowattage of the electron beam generator, size of the room, room geometry, and occupancy of adjacent areas. An alternate scheme has been successfully used and may result in lower cost for the facility. It consists of building two walls of timber and planking and filling the space between with poured sand as a barrier. Such shielding has the advantage that it is easily dismantled with reclamation value to the materials. A possible disadvantage lies in the difficulty of constructing such barriers in the









On this and the following page are shown four possible arrangements and corresponding space requirements.

larger size needed for the machines of high voltage. The lower density of the sand as a barrier requires that its thickness be about 70 per cent greater than the concrete thickness. This will require a greater over-all floor area.

* * *

The materials used in the irradiation area are dependent upon two principal factors. The first is the ability to withstand ozone formed in the beam area by those electrons which are absorbed in air rather than the product. The other is minimizing the production of x-rays to reduce shielding requirements. Aluminum, stainless steel, and well painted surfaces have all proved to be resistant to the effects of the ozone. From the standpoint of x-ray protection it is desirable that metals in the actual beam area be the lighter ones as aluminum. Whenever possible the product should be self-supported in the actual beam volume.

* * *

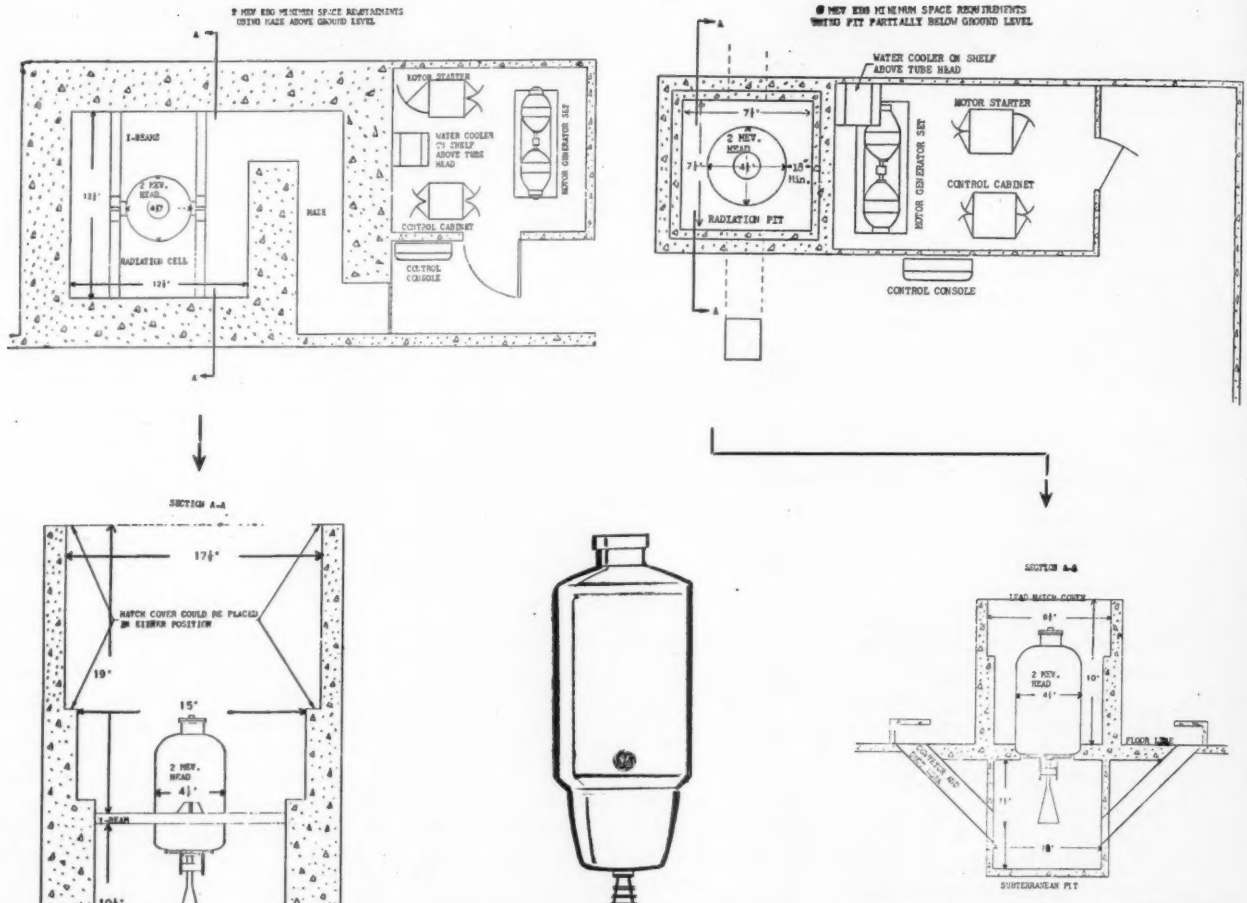
Considerable attention must be given to the design of passages for the material in order to keep radiation leakage to low levels. In some cases it may be possible to thread the wire through the maze. This has the advantage that the passage is large and access at any point is easy. Slots or openings in the barrier walls are the common way of providing entrance and exit for the product. In the design of such slots it would be best, from a radiation protection point of view, to have a turn in the slot as it passes through the wall; however, this can result in complicated and difficult threading of material. Accordingly, it is best to design straight slots which pass through the wall in such a way that they do not point toward beam areas of high radiation intensity. For example, they might be at an angle with line of sight to the tank of the generator inside. It is relatively easy to change the direction of travel of the wire inside the chamber and guard the end of the slot with an auxiliary radiation shield.

* * *

Since ozone is a hazard to operating personnel it is necessary that ventilation be provided for the irradiation room. This ventilation usually consists of two types, primary ventilation of the irradiation area and additional secondary exhausts in the ceiling of the irradiation room. Over-all ventilation should be provided in the facility to the extent of about 2 changes of room volume air per minute. When the equipment is turned off it is usually desirable to provide a time delay so that personnel cannot enter the irradiation room until the ozone concentration has been reduced to a safe level. The exhaust air from the irradiation cell is vented through a stack to the atmosphere where the ozone concentration is reduced by dilution with outside air.

* * *

Viewing of the irradiation process can be accomplished in several ways. A mirror system is often used to take advantage of the maze path. Somewhat more elegant and versatile is the use of an industrial television monitor. Another method is the use of a direct view window in the wall of the room. This gives a very direct view and the operator can view the process with the machine and the materials transport



Sketch of electron beam generator and processing fixture.

controls at arms length. The window must, however, be of radiation absorbing glass, liquid filled or otherwise suitable to absorb the radiation and protect the operator. Scattered electrons will darken most glass and lenses. An easily replaceable sheet of plate glass will protect the mirrors, windows, and lenses from darkening.

* * *

The control room area does not need to be very large. It need only contain the electron beam generator console and power cabinet, processing controls, viewing system, and the necessary equipment to reel and unreel the wire into the irradiation room. The control area is usually located near the entrance to the irradiation room.

* * *

The accessory component room contains the equipment which usually does not require any adjustments during the normal operation of the irradiation process. The motor generator set and starter which supplies the power to the generator, the high frequency electron scanning oscillator, the water cooler used to cool the insulating gas in the transformer, the air compressor which provides water, oil, and particle free air to cool the window of the electron tube, and the exhaust blowers for the removal of ozone are all usually located in this room. The room should be well ventilated to prevent overheating of the equipment.

* * *

From a safety standpoint an interlock system is provided to prevent access of personnel to the irradiation area. The general rule is that when the machine is on, people are out. If people gain access, the machine is automatically turned off. Installation of a main line switch in the irradiation room is desirable. A time delay and alarm system is also desirable. Should any one inadvertently be in the irradiation room when the equipment is turned on, they would be warned and have time to leave, or they could shut the equipment off by pulling the main line switch. There is no danger to operating personnel with proper installation of equipment and radiation monitoring as a safeguard. The accepted standards for monitoring begin with a survey of the completed irradiation facility. This is considered necessary to make sure that the shielding design is adequate and that actual construction variances have not produced a hazard.

* * *

During operation of the facility it is expected from industrial health standards that a personnel monitoring system will be set up.

(*Please turn to page* 1366)

The Manufacture and Properties of Basic Oxygen Steel for Wire Products

by

H. B. Emerick
Director of Technical Services

and

S. Kreisberg
Wire Mill Metallurgical Supervisor

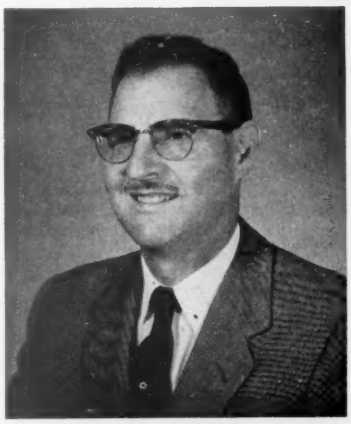
Jones & Laughlin Steel Corporation
Pittsburgh, Pennsylvania

H. B. Emerick

Mr. Emerick joined the company in 1935 as Metallurgical Investigator. In 1937 he became Assistant Supervisor of the Steel Works Metallurgical group and Supervisor the following year. In 1947 he was appointed Assistant Chief Metllurgist at the Aliquippa Works and in 1951 was made Assistant to the Vice President — Technology. He became Assistant Director of Technical Services in 1953 and Director in 1955. He attended the Night Engineering School at Carnegie Institute of Technology from 1932 to 1938, receiving training in metallurgy, completing a similar course at the University of Pittsburgh in 1950.

Mr. Kreisberg joined Jones & Laughlin in 1933, engaging in metallurgical and technical work. After graduating from the University of Pittsburgh in 1929 he joined Bethlehem Steel at Johnstown, Pa., was with Pittsburgh Steel briefly, doing wire research, and when he became affiliated with Jones & Laughlin he was successively Wire Rope Investigator (1938), Wire Development Metallurgist (1950), Chief Metallurgical Inspector — Wire (1953), and was promoted to his present post in 1957.

The paper was prepared for presentation at the Annual Convention of The Wire Association on October 14, 1959, at Cleveland, Ohio.



S. Kreisberg

Introduction

In 1958, the iron and steel industry of the United States used a record total of 28.8 billion cubic feet[1] of manufactured oxygen. About one-third of this amount was used for surface conditioning, scrap preparation and other uses including burning and welding. The remainder was used to speed metallurgical operations in the smelting of iron ores and the refining of steel. More than 13 billion cubic feet of air-extracted oxygen went into steelmaking furnaces, where oxygen is widely used for open hearth flame enrichment and for acceleration of refining reactions by direct injection in open hearth, electric and basic oxygen furnaces.

* * *

The use of high-purity gaseous oxygen instead of air for refining molten iron was first suggested over 100 years ago. At that time, however, no one knew how to produce pure oxygen on a large scale and practical application of the idea had to await development of an economical method for removing oxygen from the atmosphere. Such a breakthrough occurred in Germany a few years before the Second World War. It was not until 1949, however, that commercial development of a pure oxygen steelmaking process was undertaken. By 1953, this work[2] had culminated in the construction of two full-scale plants, at Linz and Donawitz in Austria, which made high quality steel in 30-ton basic-lined furnaces by an entirely new top-blown oxygen process that derives heat energy from exothermic chemical reactions and requires no auxiliary fuel.

* * *

Since that time, the basic oxygen steelmaking method has experienced phenomenally rapid growth to its present established position as a mature commercial process. In addition to a number of plants in various foreign countries, six plants are now operating in Canada and the United States and several others are in the construction or planning stage. As of January 1, 1959, the American Iron and Steel Institute listed United States production capacity for basic oxygen steel at 4,033,160 ingot tons annually, which makes it the third ranking steelmaking process in this country. World capacity is expected to exceed 14 million ingot tons by the end of 1959. Of this figure, United States and Canadian plants will account for almost 6 million tons.

* * *

In November 1957, Jones & Laughlin became the first manufacturer of basic oxygen steel among the major integrated steel producers in the United States. While the process had its beginnings in Europe some ten years ago, literature references concerning its application on wire products are quite limited and extend back only a very few years.

* * *

(1) References are at the end of the paper.

In October 1957, at The Wire Association meeting in Chicago, a paper[3] was presented by **Ivan P. DeWitte** of Belgium. He concluded by stating that "Whereas some years ago many steel wire applications required open hearth steels, today such cases are comparatively rare." The acceptable alternate steelmaking method to which DeWitte referred is the L-D or Linz-Donawitz process. In America, that process is identified generically as the Basic Oxygen process.

* * *

The first part of this paper describes the technology and equipment employed in basic oxygen steelmaking operations, including the large scale manufacture of high-purity oxygen which in itself is a relatively new industry. The second part of the paper presents a discussion of basic oxygen steel rod and wire properties and applications.

Facilities For Oxygen Steelmaking

The basic oxygen process combines the desirable metallurgical characteristics of basic open hearth steel with the productivity advantages of pneumatic converter processes. In this process, which is illustrated schematically in Figure 1, molten blast furnace (or cupola) iron is refined to steel in a basic-lined, solid bottom furnace by directing a high velocity jet of pure oxygen vertically onto the surface of the hot metal bath. The kinetic energy of the gas stream enables it to penetrate the molten metal and convert it to steel with a high degree of chemical efficiency.

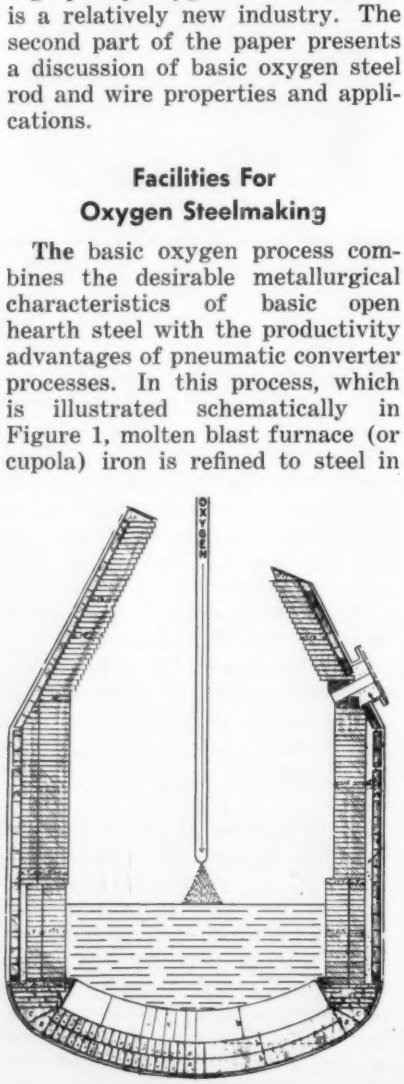


Figure 1—Schematic Illustration of Basic Oxygen Steelmaking Process. * * *

* * *

A major advantage of the basic oxygen process is its remarkable flexibility in handling a wide range of raw materials. The process can be operated on any kind of hot metal that can be used in the open hearth furnace and, in addition, it will accommodate iron of a type which is normally unsuitable either for the open hearth or conventional converter process. The new oxygen steelmaking plants around the world operate on blast furnace metal which covers a range from 0.2 to 2.0 per cent silicon, from 0.4 to 2.5 per cent manganese, and up to 0.3 per cent phosphorus with a single slag. When powdered lime is injected through the lance with the high-pressure oxygen stream it is possible, in a multi-slag process, to accommodate iron containing up to 2 per cent phosphorus.

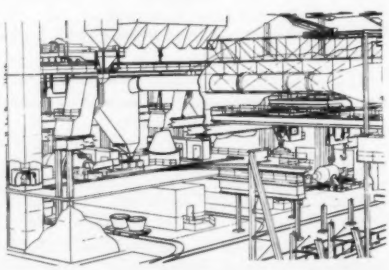


Figure 2—Perspective View of Basic Oxygen Steelworks * * * * * * *

Figure 2 is a perspective view of Jones & Laughlin's new basic oxygen plant located at Aliquippa, Pennsylvania. The plant includes two furnaces and foundations for a third furnace, each with a nominal charge capacity of 90 tons per heat. Experimentally, a metal charge weighing 120 tons has been utilized and still larger furnaces have been designed. The working lining of the furnace consists of tar-bonded dolo-magnesia bricks. The pattern of operation is for one furnace to be in use continuously while the other is being relined; lining life currently averages close to 200 heats over a period of about seven days. Total rated capacity of the Aliquippa plant is 750,000 tons of ingots per year. Jones & Laughlin recently announced plans to construct a new basic oxygen steel plant in Cleveland, Ohio, with two 160-ton furnaces having a total annual rated capacity of 1,200,000 ingot tons.

* * *

The success or failure of an oxygen steel plant naturally depends heavily on the air separation plant. At Aliquippa, oxygen at 99.5 per cent purity is furnished by two completely independent 115-ton per day oxygen generators. These generators produce oxygen through a process in which air is compressed, cooled, and then expanded to produce liquid air. This liquid air is then fractionated in a double distillation column; high-purity nitrogen comes off the top of the column in gaseous form while oxygen is pumped from the bottom of the column as a liquid. Most of this compressed liquid is for direct steel plant use following vaporization in a counter-current heat exchanger against incoming air flow. A portion is put directly into insulated storage vessels from which liquid oxygen is vaporized as required to make up any production lost when a generator may be temporarily out of service. Surge storage is provided for 500,000 cubic feet of oxygen in gaseous form at 450 pounds pressure to absorb abnormal variations in oxygen utilization pattern at the steelworks.

Method Of Operation

Domestic scrap accounts for 25 to 35 per cent of the total metallic charge; the remainder is molten blast furnace iron. After these two materials have been charged, the furnace is rotated to an upright position and a retractable water-cooled copper-tipped oxygen lance is lowered into place directly above the surface of the bath. Oxygen emerges from the jet nozzle at about 6500 cubic feet per minute under a pressure that may be regulated over a wide range but usually is held between 140 and 180 pounds per square inch.

* * *

Impinging on the surface of

the liquid bath, the oxygen instantaneously starts reactions leading to the formation of iron oxide, part of which diffuses rapidly through the bath. Carbon monoxide is released in large quantities which gives rise to a vigorous stirring action. This agitation serves continuously to bring new portions of the melt into the reaction zone so that at no time during the refining period do major differences in composition exist within the bath.

* * *

Immediately following ignition of the oxygen gas stream, slag-forming fluxes in measured amounts are added through an inclined gravity chute built into the side of a moveable water-cooled hood that covers the furnace. Due to the high temperature attained beneath the oxygen jet, a fluid reactive slag is formed early in the process which assures efficient removal of phosphorus and sulphur. The temperature is also high enough to vaporize some iron and manganese which react with any surplus of oxygen, preventing it from entering the bath. Tapping temperature is controlled by immersion thermocouple. The progress of metalloid elimination during the course of a typical low carbon basic oxygen heat is shown in Figure 3. In the production of high carbon heats, a predetermined time period of oxygen flow at a regulated rate provides a good working basis for endpoint control.

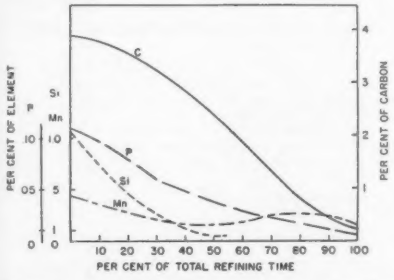


Figure 3—Metalloid Elimination as a Function of Refining Time in Oxygen Steelmaking. *

Effluent gases are drawn into a water-jacketed hood where sufficient air is infiltrated to burn the carbon monoxide to carbon dioxide. The gases then pass through a spark box where water sprays cool the gas stream to processing temperature and the larger size dust particles are dropped out. An externally insulated duct system carries the moist gas to a high-voltage electrostatic precipitator which has the capacity to clean 238,000 cubic feet of gas per minute. Cleaned gas is discharged to the atmosphere through an induced draft fan and stack.

Chemical Composition And Product Applications

Finished oxygen steel is quite low in phosphorus, sulphur and nitrogen content, with correspondingly low segregation of these elements in the ingot. Tests have shown that basic oxygen and open hearth steels of similar grade have similar ranges and levels of oxygen content. Frequency distribution data for ladle analyses on several thousand basic oxygen heats made by Jones & Laughlin during 1958 are shown in Figures 4, 5 and 6.

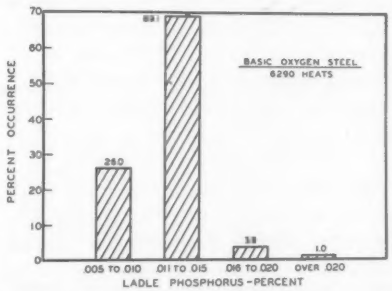


Figure 4—Frequency Distribution of Basic Oxygen Ladle Phosphorus Analyses. * *

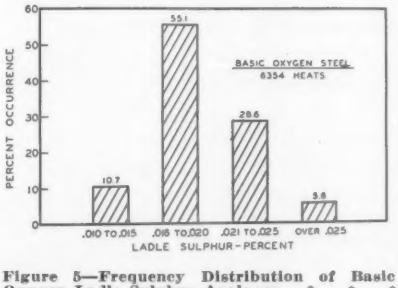


Figure 5—Frequency Distribution of Basic Oxygen Ladle Sulphur Analyses. * * *

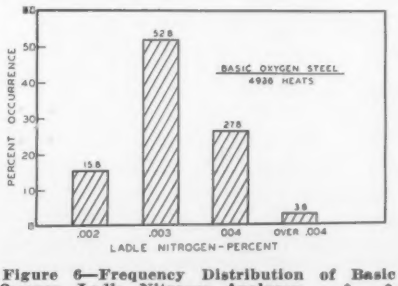


Figure 6—Frequency Distribution of Basic Oxygen Ladle Nitrogen Analyses. * *

The average phosphorus content is .012 per cent, the average sulphur content .019 per cent, and the average nitrogen content .003 per cent. It will be noted that only 5.6 per cent of all heats produced exceeded .025 per cent ladle sulphur. The following factors aid in promoting efficient desulphurization: (a) there is no contribution of sulphur to the system by the fuel; (b) a portion of the sulphur is eliminated by direct oxidation and leaves the system in the waste gases; (c) a high degree of slag fluidity and excellent slag-metal contact favor maximum removal of sulphur in the slag.

* * *

Since blast furnace iron constitutes the bulk of the charge in the basic oxygen process, undesirable "tramp" elements such as copper, nickel, chromium and tin can be closely controlled. By using iron ores in the blast furnace which are virtually free from these contaminant elements, and using no purchased scrap in the oxygen furnace charge, residual alloy elements in the finished steel can be held to quite low values.

* * *

Low-carbon steels with these chemical characteristics would be expected to possess excellent welding and cold forming qualities. That this is indeed the case is proven by successful application of large tonnages of basic oxygen steel for products such as cold reduced electrolytic tinplate, welded pipe, cold rolled sheet and strip, rods for electric arc welding electrodes, wire for cold heading and cold extrusion, and a wide variety of other uses. Experience to date in commercial application of basic oxygen steel has shown qualities generally equal to high quality open hearth grades of similar chemical composition. In applications where desired quality characteristics are directly related to chemical composition — particularly minimum sulphur, nitrogen or residual alloy content — basic oxygen steel frequently shows measurable superiority.

Rod And Wire Applications

Due to the newness of the basic oxygen process, all rod and wire applications were developed with

each customer on a trial-order basis, progressing through initial production lots to repeat production tonnage. Figure 7 shows the end-use distribution for some 50,000 tons of wire mill products made from basic oxygen steel. The information may be tabulated as follows:

End Use	*Per Cent of Total Tonnage*
Welding wire	53
Cold heading, extrusion and cold rolling	18
Cold bending and crimping	9
Special forming and spot welding	8
Plating	6
All other	6

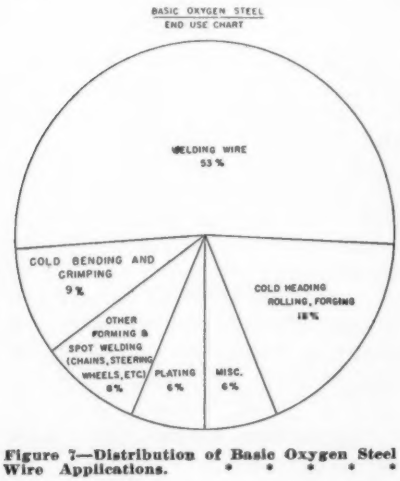


Figure 7—Distribution of Basic Oxygen Steel Wire Applications. * * * * *

It will be seen that four-fifths of the production has been used for welding wire and various cold forming operations. The fourth category includes chain wire and steering wheels. The "All other" group consists of (a) rods for fine wire, (b) link fabric wire, (c) hog ring wire, (d) garment hanger wire, (e) galvanized mesh, and (f) miscellaneous forming.

Low Carbon Wire — Mechanical Properties

Tests on wire processed from basic oxygen steel reveal that mechanical properties of the drawn wire are similar to those of highest quality open hearth steel. Actually, for a given wire size drawn from the hot rolled rod, the tensile strength range of C-1008 basic oxygen steel overlaps but averages slightly lower than open hearth steel. (Figure 8). Figure 9 shows the "Tensile Strength — Per Cent Draft" curve obtained upon drawing a low carbon No. 5 rod to .012" in 19 drafts on three continuous wire drawing machines in succession. This demonstrates the excellent drawability of basic oxygen steel. The graph for per cent reduction of area at tensile fracture is also shown in Figure 9. It averages 2 to 3 per cent higher than for comparable sizes in open hearth steel.

* * *

Details concerning one item may serve to bring out more clearly this beneficial property of basic oxygen steel in low carbon wire. Hog ring wire, 15 gage (.072"), has been made commonly in direct drawn C-1008 analysis to obtain the requisite combination of (a) ductility, (b) drawability and (c) clean bright finish requirements for this upholstery fastener. However, there is an increasing tendency for the ring to open or pull apart in the newer auto seat constructions. Hence, a higher strength wire was desired by the seat manufacturer. With basic oxygen steel this was readily accomplished by using a higher carbon C-1015 analysis, which could withstand the required heavy drafting while maintaining a higher degree of ductility than would have been possible with open hearth steel of comparable carbon content.

* * *

Upset tests on the low carbon grades of basic oxygen steel reveal a cold heading quality at least equivalent and in some instances superior to open hearth. This quality depends upon (a) good surface and (b) plasticity, which are related to a low level of chemical elements regarded as "impurities" in the steel — particularly sulphur, nitrogen and certain residual elements. Improved headability for basic oxygen steel has been demonstrated on some of the most difficult jobs, including recessed head screws and large head carriage bolts.

Welding Wire

As previously indicated, its low content of sulphur, phosphorus, and residual elements makes basic oxygen steel particularly desirable where chemical composition is of paramount importance, as in welding wire. Consider, for example, the large tonnage .08/.13 per cent carbon mild steel electric arc weld-

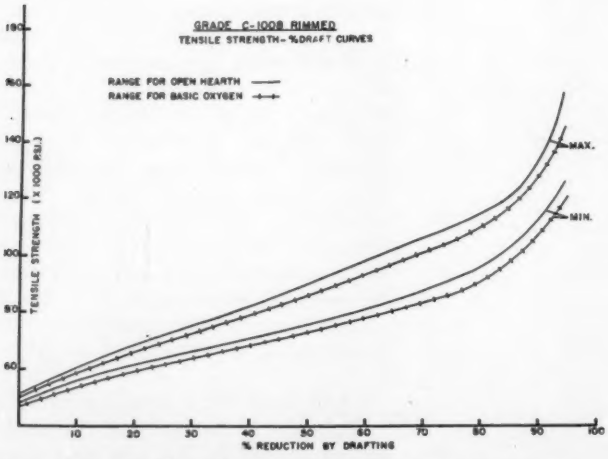


Figure 8—Tensile Strength vs. Draft Curves for Low-Carbon Open Hearth and Basic Oxygen Steel Wire. * * * * * *

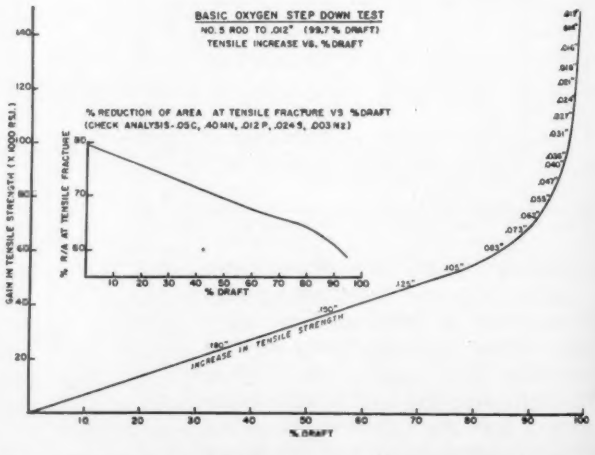

BASIC OXYGEN STEP DOWN TEST
NO. 5 ROD TO .012" (99.7% DRAFT)
TENSILE INCREASE VS. %DRAFT
% REDUCTION OF AREA AT TENSILE FRACTURE VS %DRAFT
(CHECK ANALYSIS-.05C, .40MN, .012P, .024S, .003N2)
% R/A AT TENSILE FRACTURE
% DRAFT
GAIN IN TENSILE STRENGTH (X 1000 PSI.)
INCREASE IN TENSILE STRENGTH
% DRAFT

Figure 9—Tensile Strength Increase vs. Draft for No. 5 Rod C-1008 Basic Oxygen Steel Direct Drawn to .012". * * * * *

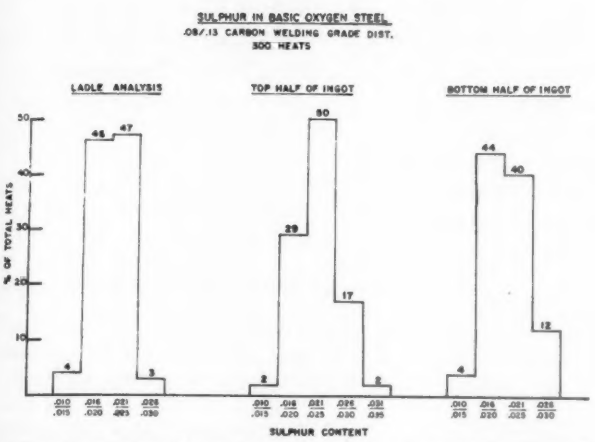


Figure 10—Sulphur Content in .08/.13% Carbon Arc Welding, Rimmed Basic Oxygen Steel * * * * * * * * * *

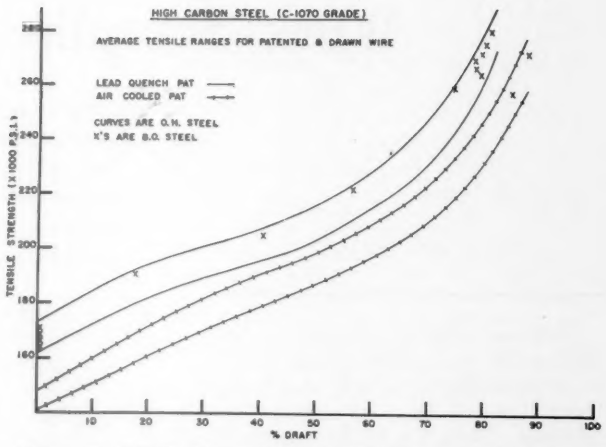

HIGH CARBON STEEL (C-1070 GRADE)
AVERAGE TENSILE RANGES FOR PATENTED & DRAWN WIRE
LEAD QUENCH PAT
AIR COOLED PAT
CURVES ARE O.H. STEEL
X'S ARE B.O. STEEL
TENSILE STRENGTH (X 1000 P.S.I.)
% DRAFT

Figure 11—Tensile Strength vs. Draft Curves for High-Carbon Open Hearth and Basic Oxygen Steel Wire. * * * * *

ing grade. Here, special precautions must be taken by the steel manufacturer to control the carbon and manganese within rather narrow limits; also, to maintain a low level of the "impurity" elements. Low sulphur content particularly is essential for maximum uniformity and soundness of welds.

* * *

As with the open hearth process, chemical control for basic oxygen welding wire is accomplished by:

(a) Careful selection of raw materials.
(b) Controlled deoxidation.
(c) Ingot croppage and billet discard practice.
(d) An elaborate check analysis system.

* * *

Experience with the welding wire grade in basic oxygen steel has shown:

(a) Chemical check analysis diversions for carbon and manganese are in the same order of magnitude as those for open hearth steel.
(b) Phosphorus content on check analysis averages somewhat lower than for open hearth steel.
(c) Lower sulphurs.

* * *

Statistical data on ladle sulphur distribution for basic oxygen steel of all types have already been presented. In a separate study involving welding wire grade exclusively, 300 heats were investigated on the basis of ladle analysis and chemical element checks representing the top half and bottom half of the first and last ingots of each heat. Since this was a study of heats within defined "maximum" sulphur limits, only the **highest** sulphur check from each half-ingot was used. Results are shown in Figure 10 and are summarized as follows:

	Sulphur Content Within:			
	.035 Max.	.030 Max.	.02b Max.	.020 Max.
Ladle	100%	100%	97%	50%
Top Half	100%	98%	81%	31%
Bottom Half	100%	100%	88%	49%

* * *

A new welding wire application is in nuclear reactor construction. Legat and Fogy[4] report that "In the field of atomic engineering, welding electrodes of the L-D (Basic Oxygen) process have proved to be first rate." Jones & Laughlin has supplied experimental quantities of low carbon rimmed basic oxygen welding wire for this purpose.

High Carbon Wire

Several heats of basic oxygen C-1070 grade have been made, some of which received rope wire processing. Results obtained are comparable to open hearth steel as regards uniformity of chemical composition and wire properties. Chemical analysis uniformity is illustrated for two representative heats in the following table:

Heat	Test Location	Per Cent Element C	Mn	P	S	Si	Ni
A	Ladle	.68/.69	.71/.72	.015	.015	.20	.004
	Billets	.68/.71	.76/.77	.015/.016	.013/.015	.20	.004
	Rods	.68/.71	.71/.74	.015	.013	.20	--
B	Ladle	.68/.69	.71/.71	.014	.014	.19	.004
	Billets	.68/.71	.75/.75	.013/.014	.013/.014	.19	.004
	Rods	.68/.70	.71/.73	.015	.015	.20	--

* * *

Note particularly the low phosphorus and sulphur analyses obtained. These heats were made by the "catch-carbon" method, using a special technique to obtain accelerated phosphorus removal as compared with data plotted in Figure 3.

* * *

Patented wire physicals were in line with regular open hearth results. Using standard rope wire drafting practices and normal production speeds, torsion specifications and wrap tests were met readily. Reverse bend values were comparable with C-1070 open hearth rope wire. Figure 11 shows "Tensile — Per Cent Draft" ranges for C-1070 grade, open hearth quality, and the average tensile strength values (marked "X") for the basic oxygen items — which all fall within these ranges.

* * *

European producers with much more experience in the high carbon grades are enthusiastic in their evaluation of high strength L-D (or basic oxygen) wire quality. Their claims [4,5] extend to hard drawn and heat treated spring wire applications as well as to rope wire.

Summary

1. **The basic oxygen process is a new and rapidly growing steelmaking process which produces a high quality product.**
2. **Wire physicals and performance compare favorably with quality open hearth steels for a wide variety of low carbon applications.**
3. **Basic oxygen steel has extra merit where control of chemical composition is a decisive factor, such as for welding wire.**
4. **Excellent results have been experienced with initial heats of high carbon basic oxygen steel for rope wire.**

(*Please turn to page* 1395)

Work Sampling in a Nail Mill

by Joseph T. Weir
Research Statistical Engineer
American Steel & Wire Research Laboratories
American Steel & Wire Division
United States Steel Corporation
Cleveland, Ohio

This is a demonstration of the application of a "Work Sampling" or as sometimes called, a "Ratio Delay" study to a practical mill problem. This is a statistical technique, which through the use of random observations, provides as much information about an activity as can be obtained by continuous or "stop watch" observation.

* * *

The mathematics of Work Sampling are quite simple and are based on that law of probability which states that a small number of chance occurrences tend to follow the same distribution pattern that a large number produces. For instance, if you observe a person or a machine for a number of times at completely random intervals, you will eventually learn how efficiently that person or machine is working, and to a definite measured degree of accuracy. It is a very simple way of obtaining information even on large, complex operations.

* * *

A unique and very welcome property of Work Sampling which should encourage its use is the fact that you can easily decide when to stop your observations with the assurance that your information is sufficient and valid. In Figure One, when the curve generated by accumulated observations of the characteristic under study levels off and additional observations create no further significant change, it is time to stop.

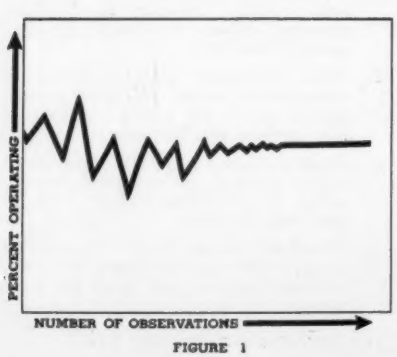


FIGURE 1

* * *

This brings us to the problem which we wished to resolve; could descaled wire be substituted for acid cleaned wire in the manufacture of common nails?

* * *

Ordinarily, in a problem such as this, we would select some criterion common to each process like nail die life, run a series of tests on each type of wire and compare the results. These results then would form the basis for management decision. However, in this instance, past records available showed that on acid cleaned wire, nail dies had an average life of 10,000 pounds with a range of from 2000 to 30,000 pounds. From this information, the number of die life tests to be run on descaled wire to provide a preselected level of reliability in the comparison, could be calculated. The number of tests necessary came to the ridiculous total of over 300, and with an expected average of 10,000 pounds of wire per test amounted to some 1500 tons.

* * *

Since this approach was out of the question, a Work Sampling study was suggested. Through this technique, nail machine efficiency was to be determined while running each type of process wire.

* * *

The procedure was as follows:

A. One group of four nail machines was selected at random for study.

B. Total machine efficiency was to be measured (machine running time) along with the following selected list of downtime elements.

1. **Mechanical Failure**
2. **Cutter adjustment**
3. **Cutter replacement**
4. **Nail die adjustment**
5. **Nail die replacement**
6. **Hammer adjustment and/or replacement**
7. **Feed adjustment**
8. **Loading Wire**
9. **Kicker adjustment**
10. **Machine lubrication**
11. **Size change**
12. **Miscellaneous**

C. Observations were made at random intervals throughout the two operating turns.

D. The observations were made by turn foremen without disruption of their normal duties.

E. The study was terminated when continuing observations caused no significant change in accumulated values.

This procedure was followed during test runs on both acid cleaned and descaled wire in that order.

Joseph T. Weir

The author holds a B.S. Degree in Chemistry from John Carroll University in Cleveland. He started with American Steel & Wire in 1936 and was foreman in the Central Die Station from 1941 to 1945. In 1945 he was made Research Metallurgist in the Research Laboratory and in 1950 was appointed to his present position there. He is a Senior member of the American Society for Quality Control and is a member of the Metals Technical Committee of the Society.

The paper was prepared for presentation at the Annual Convention of The Wire Association in Cleveland on October 14, 1959.

The following items were kept constant throughout the test:

1. Machine speed
2. Wire size (.162 inches)
3. Nail size (16D-.162 x 3-½ inches)

* * *

In the chart showing the per cent of machine operating time for both wires (Figure Two), it appears that the curves show a difference of about 5% which might be significant. However, in the

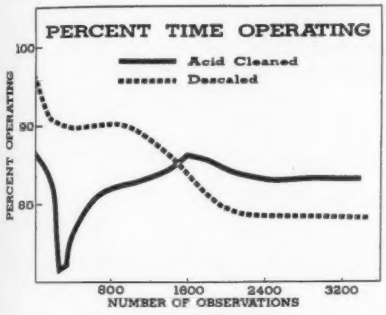


FIGURE 2

chart showing the combination of machine running time and mechanical downtime, the curves practically coincide. The seeming difference was due to the lack of mechanical attention beyond our control (Figure Three).

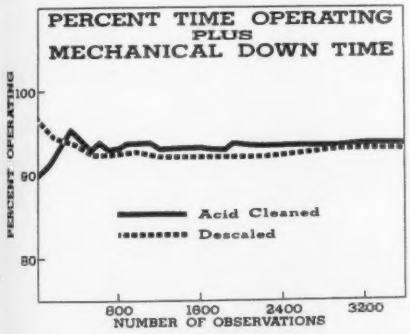
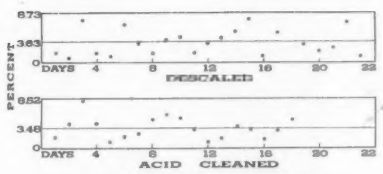


FIGURE 3

Examination of the data showed that the seemingly large and erratic percentage of mechanical downtime which caused the fluctuation in the machine running time curves was due to unusual circumstances. Because of other more important demands the mechanical help had been deployed elsewhere and thus some machines were down awaiting mechanical attention much longer than normally expected.

* * *

Figure Four shows a comparison



WORK SAMPLING CONTROL CHART
COMBINED ELEMENTS - CUTTER ADJUSTMENT, CUTTER REPLACEMENT, DIE ADJUSTMENT, DIE REPLACEMENT

FIGURE 4

of statistical control charts based on a combination of what were considered the more important elements contributing to machine downtime, viz., cutter adjustment, cutter replacement, die adjustment and die replacement. These were considered the most likely to be affected by any significant difference between the two process wires. These charts indicate no difference. However, the table of results, Figure Five, shows that cutter and die changes have increased, but this was not considered to be serious from the standpoint of availability or cost.

8 GAUGE WIRE	1 Machine Running	2 Mechanical	3 Cutter Adjustment	4 Cutter Replacement	5 Die Adjustment	6 Die Replacement	7 Hammer Adj. & Repl.	8 Feed Adjustment	9 Load Wire	10 Kicker Adjustment	11 Lubricate Machine	12 Size Change	13 Miscellaneous	TOTAL
	PERCENT													
Acid Cleaned Rods 4 Machines	83.20	8.33	2.31	.86	.42	.09	.14	.26	2.28	.14	.19		1.98	100.0
Descaled Rods Same 4 Machines	78.28	13.56	1.39	1.36	.52	.38	.06	.29	3.53	.03	.13	·	.49	100.0

FIGURE 5

As a result, we were able to recommend to management that in the manufacture of common nails, .162 inches in diameter and over, there is no significant difference in machine efficiency and/or production due to the substitution of descaled wire for acid cleaned wire. The change was made and eventually over 90% of the common nail production at this mill stemmed from descaled wire with its attendant benefits in the reduction of acid cleaning.

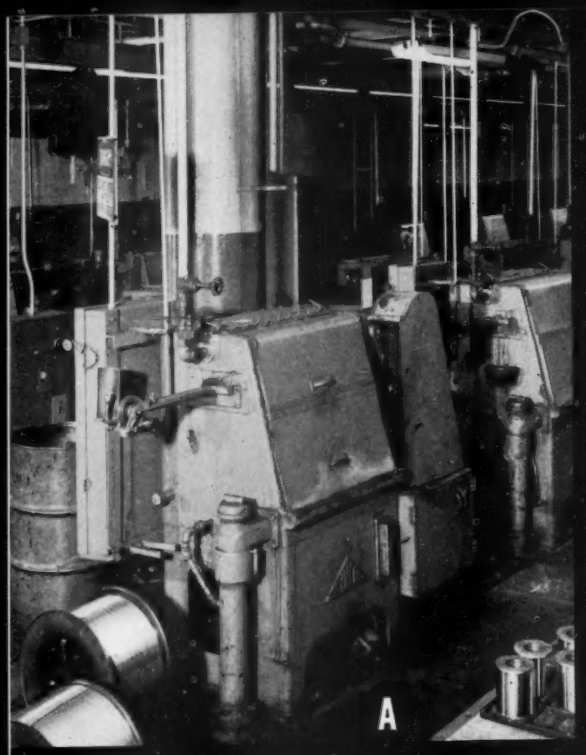
* * *

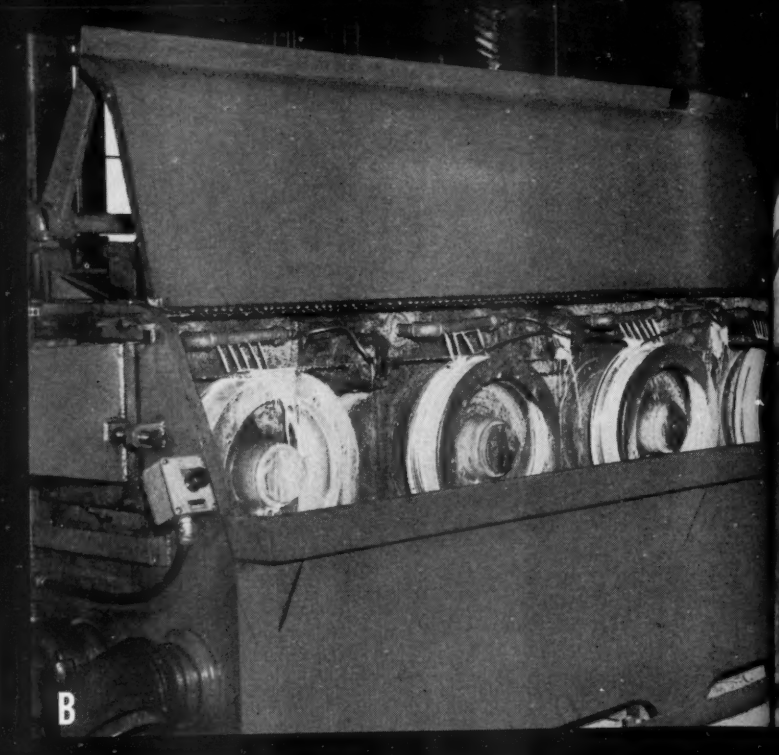
You have no doubt noticed that, since the curves generated in a Work Sampling study are kept current, any drastic interference with production, due to the switch to descaled wire, could have been easily detected and the study stopped. In a comparison of die life tests, if production suffered, much more time and tonnage would probably be lost before a reliable decision to abandon the tests could be made.

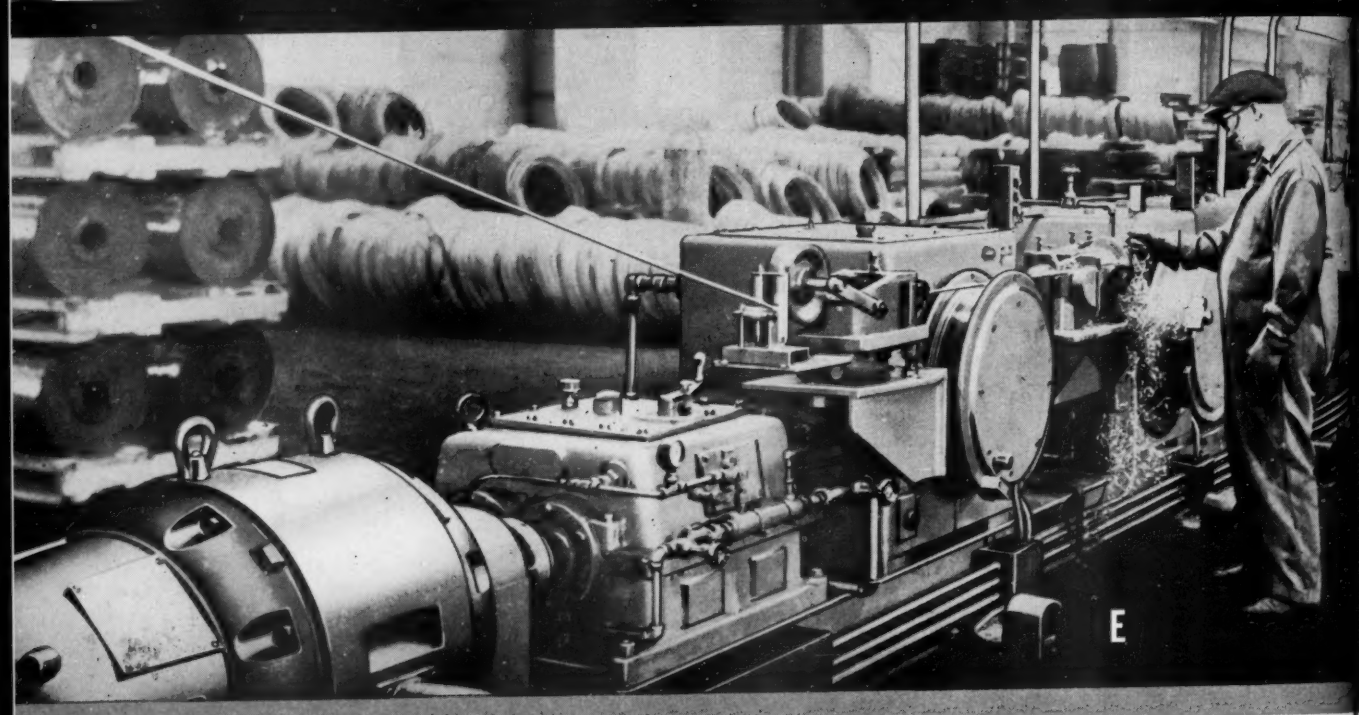
* * *

In conclusion, for the benefit of those who have not as yet used Work Sampling as a source of information, a few general rules have been listed.

1. **Select the equipment to be studied.**
2. **After careful study, prepare a list of elements which most probably contribute to equipment downtime.**
3. **Prepare a form for recording the observations. This form should list all of the selected elements with accompanying code symbols. Avoid complicated or confusing forms, keep it as simple as possible.**
4. **Choose the people who will take the observations, preferably from those familiar with the equipment.**
5. **Explain the purpose of the study to all persons concerned, including the operators.**
6. **The observations must be made *instantaneously* at pre-selected random intervals.**
7. **Accumulate the observations and keep a running accumulative chart of the equipment running time.**
8. **As a rule of thumb, stop the study when the curve on this accumulative chart levels off and additional observations do not effect the position of the curve.**
9. **If you wish to be mathematically assured of the precision and reliability of the data, consult a statistician.**







FROM DESIGN TO PRODUCTION, SPECIFY

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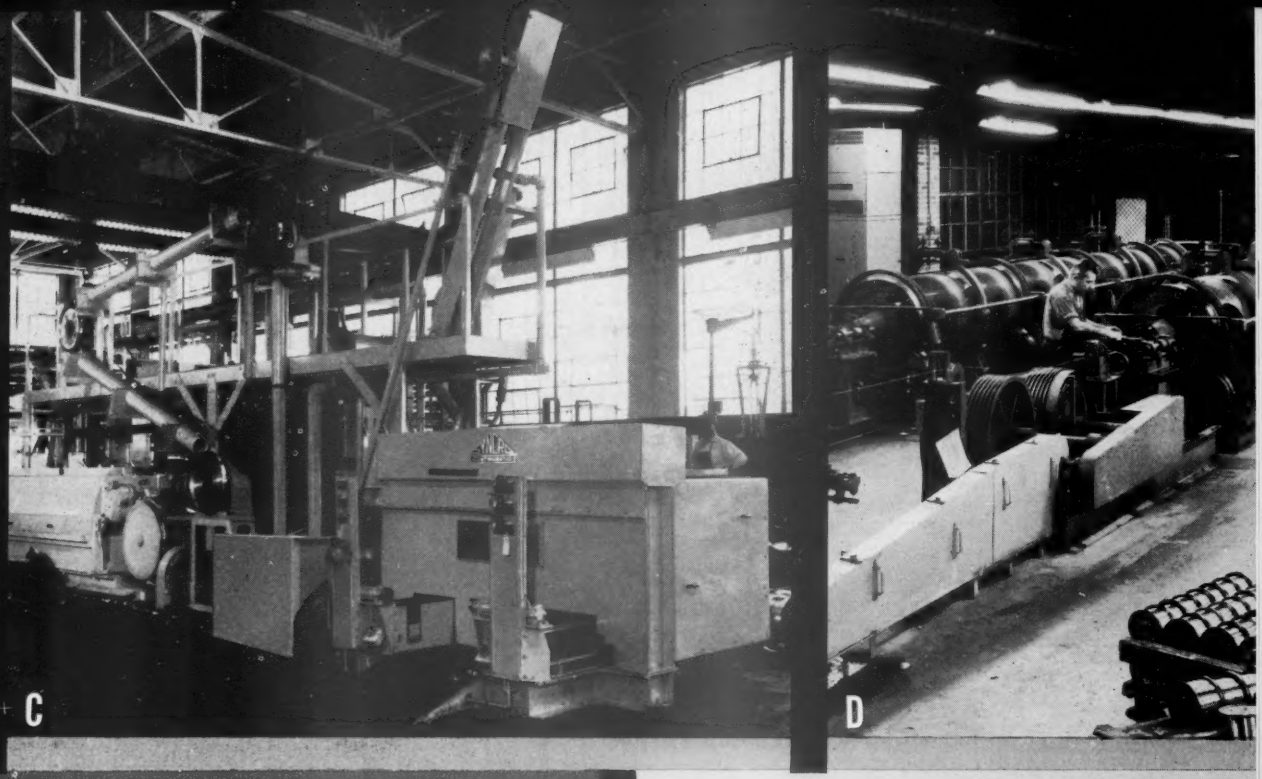

A. Fine wire drawing machine at Belden Manufacturing Company, Chicago, Illinois.

B. High speed aluminum alloy coarse wire drawing machine; Kagan Dixon Wire Corporation, Rahway, New Jersey.

C. Coarse wire drawing, annealing, and continuous reeling automated operation at Anaconda Wire and Cable Company, Hastings- on-Hudson, New York

D. High speed tubular stranders at the Hatfield Wire and Cable Company, Union, New Jersey

E. Rod shaving and drawing machine at Canadian General Electric Company, Peterboro, Ontario.

Photographs courtesy of the plants mentioned.

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The Impact of Modernization in Wire Weaving

by T. L. Stilwell
Sales Manager
The Warner & Swasey Company
Cleveland, Ohio

Two years ago at the Wire Convention in Chicago, mention was made of several new wire weaving machines in the development stages. A year ago the Warner & Swasey Company of Cleveland, Ohio, introduced one of these machines to the industry and has since delivered several batteries and some single machine units for evaluation by wire weavers throughout the country.

* * *

Basically, the Warner & Swasey-Sulzer Wire Weaving Machine is a modified textile loom of the shuttleless variety utilizing the same basic motions as those in wide use both here and in Europe. While this loom embodies the same three motions necessary to produce woven fabrics; namely shedding, picking, and beating up, we have applied mechanics to these motions which permits the production of better wire cloth produced faster and for less money than any other mechanical means.

* * *

It may appear to be a relatively simple matter to develop a loom of radical design, but there has been a tremendously expensive development program under way on the basic textile loom since 1935. The original patents were purchased by the Sulzer Brothers of Switzerland in the early 1930s. Between this time and 1943 Sulzer designed and built five different models of this machine, each successive model being revised and improved. In 1943 a small unit of these textile machines was placed in a mill in Switzerland on trial. These machines showed that a number of "bugs" still existed, and the necessary revisions were in the making when the war in Europe ended. At this time the Warner & Swasey Company successfully negotiated contracts to produce this machine in this country.

T. L. Stilwell

The author graduated from Washington & Lee in 1948 with a degree in business administration. Upon graduation he joined the Warner & Swasey Company as a Special Apprentice, specializing in textile machinery. In 1950 he was assigned to Textile Sales and subsequently transferred to Philadelphia, where he became widely known to the textile trade in the Central Atlantic States. In January of 1956 he was transferred back to Cleveland to handle the position of Assistant Sales Manager. During April of the same year Mr. Stilwell was appointed Sales Manager of Textile Machinery.

This paper was prepared for presentation at the Annual Convention of The Wire Association, in Cleveland, Ohio, on October 12, 1959.

* * *

Between 1946 and the present, a great many of these textile looms have been produced both here and in Switzerland. About four years ago we were approached by various wire weavers about the possibility of weaving by this same principle. After considerable experimentation we determined that fine aluminum, steel, or bronze wire could be processed but that several radical changes would be required.

It was first determined that widths beyond 50 inches were impractical because of the high tensions required in wire weaving. The harness motion was greatly strengthened and modified to handle only two harness frames instead of the eight on the textile loom. The take-up system was completely redesigned, the let-off system was altered to accommodate fewer picks, and the selvage mechanism was redesigned to meet the requirements of the insect screen market.

* * *

The result of all this lengthy engineering effort was to produce a highly precision made product built to machine tool standards with complete interchangeability of parts that would operate at a standard recommended speed of 240 picks-per-minute on any width from 20 to 50 inches. This is approximately three to six times the speed of conventional wire weaving equipment.

* * *

The following is a brief description of the mechanical operation of the Warner & Swasey-Sulzer Wire Weaving Machine.

* * *

The filling wire is inserted into the warp by means of a number of small shuttles which alternately grasp the wire, carry it across the machine, release the wire as it is cut, and then return on a conveyor to begin another cycle. The filler or shute wire is tensioned prior to being cut and after being beat into the cloth it extends ¼" beyond the edge of the cloth. A specially designed mechanical motion then tucks this extension back into the cloth in the form of a "U" that is locked in place by the following pick. The filler supply is usually a

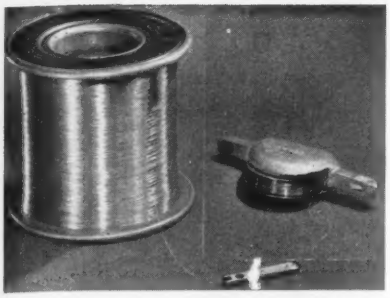


Fig. 1—Here is a comparison between the old and the new method of inserting shute. The new method eliminates the need for shuttle rewinding and expensive package carrying bobbins. * * * * * * * *

spool that is taken directly from the fine wire drawing machine and contains a two-to three-hour wire supply. An extra supply holder is provided to facilitate filler wire replacement when the original spool is depleted. The warp drum can contains up to 18,000 lineal feet of wire and is accurately actuated to deliver the proper amount of warp wire per beat by means of an automatic letoff device. The take-up system pulls the wire from the warp drum, with the help of the let-off device, at a constant rate of speed through the length of the warp resulting in a pick spacing that is always accurately maintained. A set of eight change gears allows take up gear combinations that can provide any mesh spacing from 13 to 102 in one-half mesh increments. The cloth can be rolled up to a 20″ diameter on a cloth roll under low tension and can be doffed while the machine is in operation.

* * *

The purpose of this paper is not to discuss the mechanical features of the loom itself but rather to outline some of the problems inherent in any modernization program. While many improvements have been made in wire drawing departments of wire weavers, little has been done up to now to cut the cost of the weaving operation itself. The sudden introduction of extremely high speed looms can have a tremendous impact on the entire mill. New problems are introduced that affect operations prior to weaving as well as those following. The mere possession of high-speed equipment does not insure modern efficient operation but it does offer the potential to produce quality products at low cost. Unless the mill is prepared to accept this fact and to make appropriate changes to complementary equipment and methods it is destined to lose many of the advantages inherent in high speed weaving equipment.

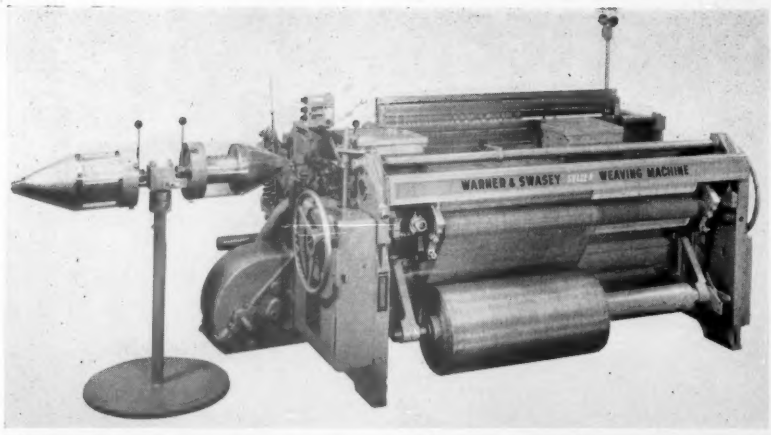


Fig 2—Shute or filler is drawn directly from stationary mill spools mounted on special holders. A reserve package can be swung into position when needed. * * * *

* * *

Probably the most important element in the mill to be affected is the personnel directly responsible for the maintenance and operations of the new looms. They are faced with a battery of machines that are producing four times as much cloth per loom per hour. The loom is so much more productive that machine efficiencies and quality control programs are tremendously important and a well instituted preventive maintenance program is essential to high efficiency operation. We recommend, in fact, insist, that anyone installing the Warner & Swasey loom first send the men responsible for maintenance of the loom to Cleveland, for training. We have a formal training program which introduces the man to the mechanics as well as preventive maintenance, lubrication, and trouble shooting various weaving and operational problems.

* * *

Modern weaving machines and qualified personnel to operate them cannot produce to their fullest advantage without alert and probing supervision. The supervisor must have the ability to organize an operation to insure a smooth flow of material and take full advantage of the man-power available. He must also have an inquiring mind that is constantly asking the question "Why?". It is usually his responsibility to develop the procedures in use and therefore he must constantly be analyzing them and altering them to satisfy the immediate situation.

* * *

The need for a tighter system of

(*Please turn to page* 1367)

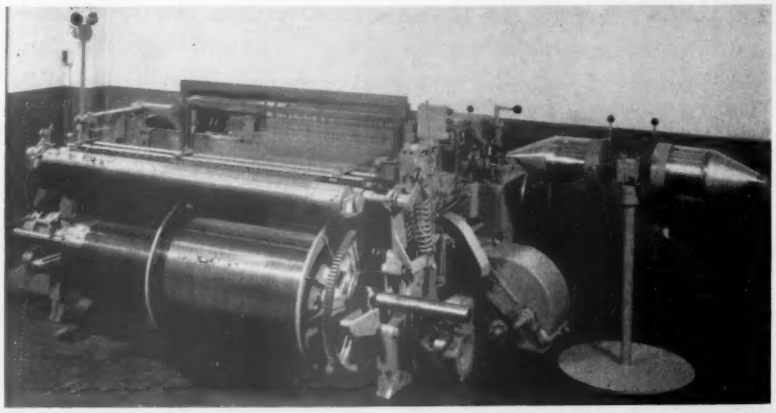
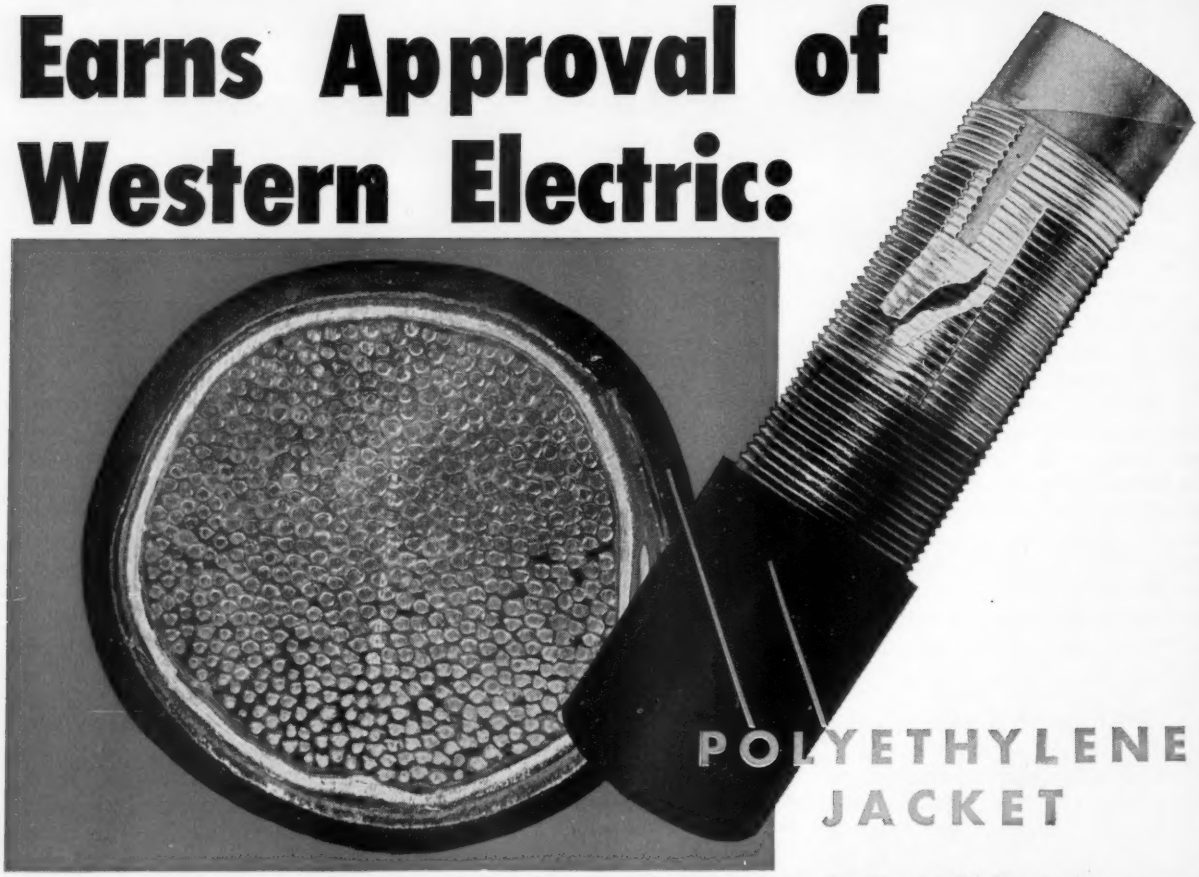


Fig. 3—The wrap drum holds up to 18,000 lineal feet of wire. The wrap let-off, working in conjunction with the cloth take-up is a positive drive completely eliminating any variation in pick spacing. * * * * * * * * * * * * * *

Spencer "Poly-Eth" 3812 Earns Approval of Western Electric:



Here's why this new Spencer resin for producing polyethylene-jacketed wire and cable meets the high acceptance standards of Western Electric:

Polyethylene is ideal as a jacketing for wire and cable because of its chemical resistance, flexibility, abrasion resistance and resistance to fatigue. But one of the most important properties required of a polyethylene jacketing material is stress-crack resistance.

This newly developed polyethylene cable-jacketing resin, called "Poly-Eth" 3812, is outstanding in its resistance to stress cracking. Test samples of the new resin have been subjected to all known laboratory tests for environmental stress cracking without failure!

This new resin has earned the high honor of having met the acceptance standards of Western Electric—the world's largest communication wire and cable producer.

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A Substitute for Silicon Bronze— Its Fabrication and Properties

by Roger E. Martin
Chief Metallurgist
Triangle Conduit & Cable Company
New Brunswick, New Jersey

Anyone who has been involved in the production of the Silicon Bronzes knows the problems involved in the casting and hot working of these alloys. One of the main problems encountered in the casting of the Silicon Bronzes is due to the fact that they pick up large amounts of gases which leads to spongy material and segregation and eventually to cracking in hot working and to a high rejection rate. Devious means are taken to alleviate these conditions. These are special covers on the melt, special fluxes and various dry dressings on the molds. However, in spite of these precautions, troubles are encountered which affect the deliveries of the alloys in large quantities, especially in times of abnormal demand.

* * *

This was brought out in a very forcible manner some time ago at a Copper and Brass Research Association meeting by a representative of the Federal Government who asked if any of the producers had a substitute for the Silicon Bronzes. He pointed out that there had been periods of critical shortage of these alloys in the past which, at times, had held up important Government projects. Moreover, it has since been learned that the high tensile strength brasses and bronzes which had been used as substitutes led to several service failures of marine components made from these alloys.[1]

* * *

At the time of the meeting none of those present had any alternate to offer. However, at a later date, while attempting to help a customer meet the competition of a new type flexible hose which was stronger than usual because of a different type braid, we experimented with the addition of varying amounts of silicon to our different alloys. We found that the addition of 0.8% to 1.5% silicon to a 90.% copper zinc alloy produced an alloy with a high tensile strength which helped the customer meet the competition.

Roger E. Martin

Mr. Martin spent four years as a Chemist with the Revere Copper & Brass Company's Taunton-New Bedford Div. and seventeen years with the Phelps Dodge Copper Products Corporation at Elizabeth where he successively was Chemist, Metallurgist and Research Metallurgist in Charge of the Research Department. In these capacities he came in contact with every phase of copper working—casting, rolling, drawing, inspection and testing. He joined Triangle in 1953.

This paper was prepared for presentation at the Annual Convention of The Wire Association on October 13, 1959, at Cleveland, Ohio.

* * *

Figure I shows the effect of silicon content and cold-working on the tensile strength of .081" diameter Silicon Brass wire. A comparison of the tensile strength values of Silicon Brass (1.25% Si) with those of Silicon Bronze "B" given in various publications and specifications is shown in Table I. Given in Table II is a comparison of the yield strength of these same samples with those of Silicon Bronze "B". Table III shows the results obtained by an independent research laboratory on a coil of .120" diameter, extra hard, Silicon Brass wire.

* * *

Our experiments also showed that the alloy could be cast in the usual Ajax-Wyatt induction furnaces using the methods and precautions normally employed in the casting of regular brass alloys. It was also found that the alloy had very good hot-working properties.

* * *

The next step in the testing of this alloy was to determine the dezincification and stress-corrosion resistance of the alloy since these were the main causes of failure in the substitute alloys. This was done by placing samples of Silicon Brass and Cartridge Brass 70%, as a control, in a 1.% aqueous solution of cupric chloride at 120-130°F for four weeks. The ability of this alloy to resist dezincification was established when no sign of dezincification was found on the Silicon Brass samples after this exposure. On the other hand, considerable dezincification was found in the Cartridge Brass samples under the same conditions.

* * *

Accelerated stress - corrosion tests were made by subjecting stressed samples of Silicon Brass and Cartridge Brass for 24 hours to the standard mercurous nitrate solution made up in accordance with ASTM Specification B 154-51 and by subjecting another set of stressed specimens for 5 days to the fumes from a 25.% ammonium hydroxide solution placed

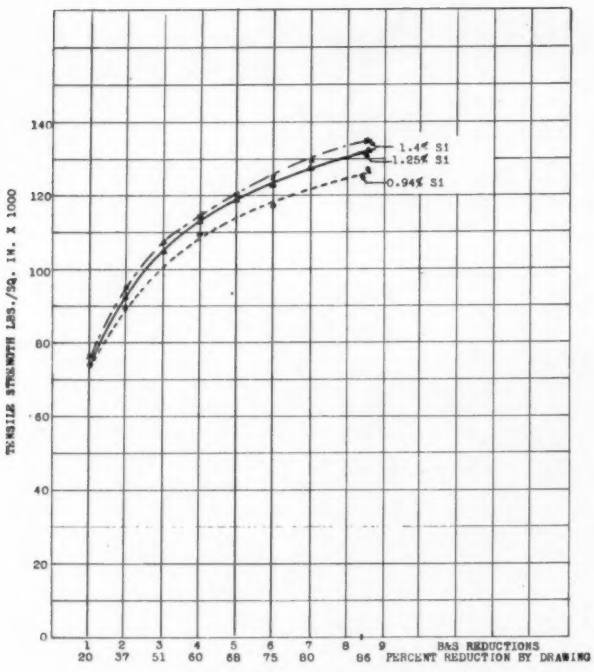

FIG. I SHOWING THE EFFECT OF SILICON CONTENT AND COLD-WORKING ON THE TENSILE STRENGTH OF SILICON BRASS (SILCALLOY)

TABLE I

COMPARISON OF TENSILE STRENGTH VALUES OF SILICON BRASS (1.25% Si) WITH THOSE OF SILICON BRONZE "B" GIVEN IN VARIOUS PUBLICATIONS AND SPECIFICATIONS

TENSILE STRENGTH-LBS./SQ. IN.

TEMPER	PER CENT COLD-WORK	SILICON BRASS(1)	CABRA ALLOY DATA (2) NO. 43b	ASTM B99-54 ALLOY B	NAVY MIL-C-17516 ALLOY #2 WIRE	FEDERAL QQ-C-591b (DRAFT) ALLOYS B&E
ANNEALED	—	54,000	—	43,000-55,000	---	40,000 Min.
1/8 HARD	10	61,000	50,000	50,000-65,000	---	50,000- 65,000
1/4 HARD	20	73,000	57,000	60,000-75,000	60,000- 75,000	60,000- 75,000
1/2 HARD	37	96,000	70,000	75,000-95,000	---	70,000- 85,000
HARD	60	110,000	90,000	90,000-110,000	90,000-110,000	90,000-110,000

(1) RESULTS ON .081" DIAMETER WIRE.

(2) REASONABLE APPROXIMATIONS OBTAINED ON .080" DIAMETER WIRE, SUITABLE FOR GENERAL ENGINEERING PURPOSES, GIVEN IN COPPER AND BRASS RESEARCH ASSOCIATION STANDARDS MANUAL.

TABLE II

COMPARISON OF YIELD STRENGTH VALUES OF SILICON BRASS (1.25% Si) WITH THOSE OF SILICON BRONZE "B" GIVEN IN VARIOUS PUBLICATIONS AND SPECIFICATIONS (RESULTS OBTAINED ON SAME SAMPLES AS IN TABLE I)

YIELD STRENGTH-LBS./SQ. IN.(3) (1/2% EXTENSION UNDER LOAD)

TEMPER	PER CENT COLD-WORK	SILICON BRASS (1)	CABRA ALLOY DATA NO. 43b(2)	FEDERAL QQ-C-591b (DRAFT) ALLOYS B&E
ANNEALED	—	19,900	------	12,000 Min.
1/8 HARD	10	49,700	35,000	20,000 Min.
1/4 HARD	20	63,000	45,000	42,000 Min.
1/2 HARD	37	68,800	55,000	50,000 Min.
HARD	60	82,300	67,000	60,000 Min.

(1) RESULTS ON .081" DIAMETER WIRE.

(2) REASONABLE APPROXIMATIONS OBTAINED ON .080" DIAMETER WIRE, SUITABLE FOR GENERAL ENGINEERING PURPOSES, GIVEN IN COPPER AND BRASS RESEARCH ASSOCIATION STANDARDS MANUAL.

(3) YIELD STRENGTH NOT REQUIRED IN ASTM B-99-54 NOR IN MIL-C-17516 (NAVY) FOR ALLOY #2 WIRE (COILED STOCK).

TABLE III

SHOWING RESULTS OBTAINED BY AN INDEPENDENT RESEARCH LABORATORY ON A COIL OF .120" DIAMETER SILICON BRASS CONTAINING 1.25% SILICON, DRAWN SLIGHTLY LESS THAN 6 B&S NOS. (73% REDUCTION BY DRAWING)

POSITION OF SAMPLE IN COIL	TENSILE STRENGTH LBS./SQ. IN.	YIELD STRENGTH .2% OFFSET LBS./SQ. IN.
END NUMBER 1	121,000	104,200
MIDDLE	120,000	103,800
END NUMBER 2	120,000	101,700

in the bottom section of a desiccator. The Silicon Brass samples showed no sign of cracking under either of the above severe conditions which caused cracking in a short time in the Cartridge Brass samples.

* * *

We felt, therefore, that the alloy had very good possibilities as an alternate for Silicon Bronze. However, in order to check the manner in which the alloy would fabricate into fasteners, we furnished the Bristol Brass Corporation with several coils of Silicon Brass rod. They drew our hot-rolled rod into various sizes popular in the Fastener Industry and had different manufacturers make them into screws and bolts, both slotted and Phillips-head type. It was reported that they were very pleased with the way the alloy fabricated. In addition, the Bristol Brass Corporation also checked the dezincification and stress-corrosion resistance of the alloy and found them to be very good.

* * *

Together we have contacted various Government agencies to urge the acceptance of this alloy as an alternate to Silicon Bronze. To date, the alloy has been entered as Alloy "E" in the draft of September 3, 1957, Federal Specification QQ-C-591b for Copper-Silicon Alloy Products and it is hoped that before too long the alloy will be incorporated in Military Specification Mil-C-17516(Navy).

Conclusions

Our experiments indicate that Silicon Brass within the range of 89. to 91.% Cu, 0.8 to 1.5% Si, remainder Zinc, would make a good alternate for Silicon Bronze. This is based on the good corrosion resistance of this alloy as well as its casting and working qualities.

* * *

In addition, because of its lower copper content, the alloy should prove more resistant than the Silicon Bronzes to attack by hydrogen sulfide and other corrosive sulfides.

* * *

The lower copper content of the Silicon Brass Alloy would also help conserve copper during times of shortages.

Acknowledgement

The author acknowledges the

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Catalyst Applications to Continuous Strip Ovens

by Richard J. Ruff, President
Catalytic Combustion Corporation
Detroit, Michigan

Throughout the ten years since the Catalytic Combustion Process was first applied to industrial ovens, the producers of magnet wire have led all other industries in pioneering the conversion of noxious waste gases to valuable heat energy. The experiences gained in meeting the insistence of wire enamelers for reliable and continuous performance have accelerated the application of the process to other industries. Whether organic coatings or impregnants are baked on metal, plastic, paper or fabrics, designs for Catalytic heat recovery on continuous wire, band, strip or web ovens trace their origin to the wire enameling industry. Current design concepts, arrangements for accomplishing intended functions, and procedures for determining the economic advantages will be discussed.

* * *

Considerable publicity directed toward use of catalysts for the oxidation of hydrocarbons precludes the necessity of discussing basic fundamentals of catalytic oxidation. In utilization of the principles, air which contains hydrocarbons is heated to a temperature of approximately 500 deg. — 600 deg. F., and then passed through a porous catalyst media where the hydrocarbons are consumed. The process continues whether the concentration is high or in trace quantities. As in any combustion process, the end products are carbon dioxide and water vapor, which are odorless and colorless. Heat is released proportional to the amount of hydrocarbons consumed.

Catalysts

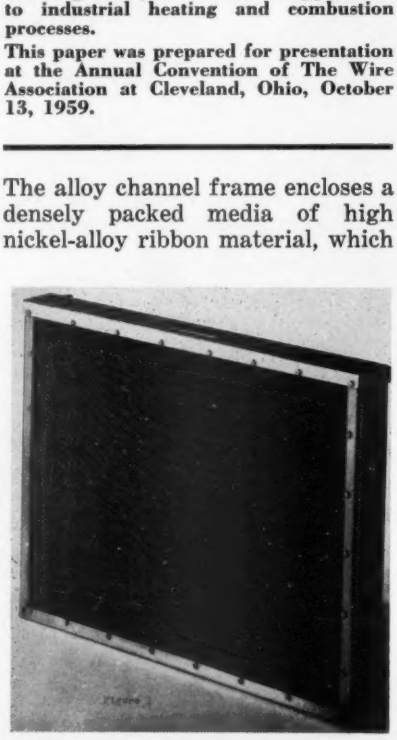
Conventionally, the catalyst is constructed in element form, similar to that illustrated in Fig. 1.

Richard J. Ruff

Mr. Ruff is an engineering graduate of the University of Wisconsin, class of 1933. He was Professor of Industrial Engineering at the Detroit Institute of Technology from 1933 to 1944 and from 1944 to 1950 was associated with several manufacturers of industrial ovens as Engineer, Sales Manager and General Manager. He organized the Catalytic Combustion Corporation in 1950 and has been President since its founding. Mr. Ruff is the holder of numerous patents covering catalysts and their application to industrial heating and combustion processes.

This paper was prepared for presentation at the Annual Convention of The Wire Association at Cleveland, Ohio, October 13, 1959.

The alloy channel frame encloses a densely packed media of high nickel-alloy ribbon material, which



provides the supporting area for the active catalyst. By electrolytic deposition, a thin coating of platinum alloys is applied to all surfaces and conditioned for activity. Thus, the platinum acts as the catalyst, and the high nickel-alloy ribbon material as the supporting media. Since the platinum alloys do not enter into the end products of the combustion reaction, the life of the element could be assumed to be infinite. This would be true, were it not for the inorganic contaminants such as dust and dirt, which are normally present in all atmosphere. Over extended periods of operation, some of these inorganic contaminants will tend to coat the active surfaces, making them unavailable for further oxidation reaction. On enamel and paint baking ovens, it is necessary to keep the oven atmosphere reasonably clean, and, as a result, accumulation of contaminants on catalysts is minimized. Since the Catalytic elements are easily and quickly removed from the housing, are light in weight, unbreakable in construction, and require no expert supervision in handling, equipment maintenance is comparable to that required of other industrial heating services. As normal preventive maintenance, it is recommended that catalysts be given a simple detergent wash once or twice a year. Many catalysts have been in use on ovens and chemical process equipment substantially in excess of 25,000 operating hours without requiring factory service. When required, the catalyst elements are exchanged for newly reactivated elements at nominal cost.

* * *

Catalytic oxidation reactions conform to definable physical and chemical laws. Hydrogen and oxy-

gen will combine and "burn" to form water vapor when passing through a catalyst at room temperature. Depending upon their molecular structure, some types of organic vapors will consume at 250 deg. — 350 deg. F., and other hydrocarbons from 450 deg. to approximately 750 deg. F. The degree of oxidation efficiency obtainable is dependent upon temperature, time and turbulence during passage through the catalyst element. In gas purification applications, it is not unusual to expect removal of a contaminant by catalysis to within one part per million, or less. However, removal efficiencies in the range of 95% is usually recognized as acceptable performance for systems applied to the exhaust of solvent evaporation ovens.

* * *

The amount of heat released by catalysis also follows fixed laws. For instance, if one gallon of gasoline, having a heat of combustion of 125,000BTU per gallon is vaporized and mixed with 10,000 cubic feet of air (70 deg. F. equivalent), the latent energy concentration of the mixture is 12.5 BTU/SCF. By thermal capacity of gases, the release of one BTU as heat energy in one standard cubic foot of air will produce a temperature rise of 55 deg. F. to that air; with 12.5 BTU/SCF approximately 687 deg. F. temperature rise is obtained in passage of the fumes through a catalyst bed. It is interesting to note that Insurance Underwriters approve vapor concentrations in oven exhaust gases as high as 12.5 BTU/SCF. Thus it can be seen that substantial amounts of heat are available in the exhaust gas of an efficiently designed solvent evaporation oven.

Functions To Be Accomplished

Catalysts installed on solvent liberating ovens ordinarily must fill one or more of the following primary functions:

A) **Consume the contaminants in the exhaust gases before release to the atmosphere, and thus meet approval of Air Pollution Control or Health Authorities . . .**

B) **Convert the fumes to heat energy for recovery to the oven, or to adjacent heating needs. . .**

C) **Improve plant safety and maintenance through condensate elimination and high-vapor limit protection . . .**

* * *

A single Catalytic System may be designed to serve either one or all these primary functions, depending on the individual needs. For instance, the Catalytic processing of only a portion of the oven exhaust gases may provide ample heat to meet the thermal demands of the oven, in which case, the balance of the vapors could be released to the atmosphere.

* * *

In contrast, where rigid Air Pollution Control Laws are enforced, decontamination of all oven exhaust gas is usually required and the extent of recovery might be limited to the process heat demands. Therefore, it can be seen that individual functional needs may dictate the design arrangement required. For wire enameling ovens, designed along conventional lines, emphasis is placed on elimination of condensate in the exhaust system, while at the same time producing approved exhaust decontamination. A typical installation on a vertical type oven is shown in Fig. 2, having internal flow arrangement similar to Fig. 3.

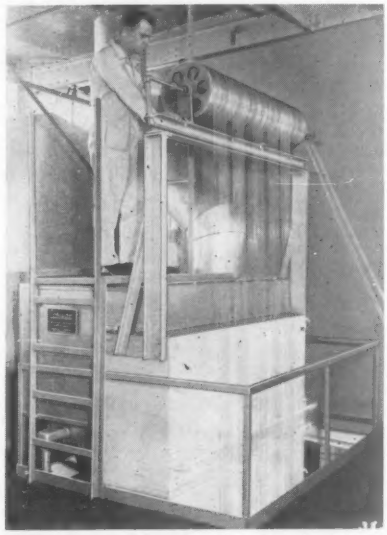


Figure 2 * * * * * * * * *

Former ventilating procedures on vertical wire enameling ovens consisted of mounting a collection hood adjacent to the top wire slot. The fumes issuing from the oven were collected in the hood, entrained with room air, pulled through

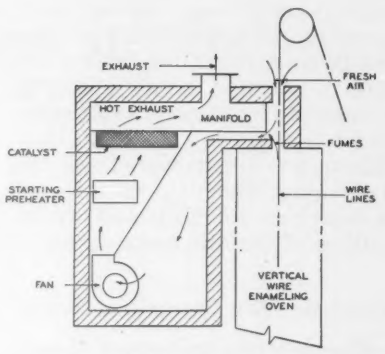


FIGURE 3

the exhaust fan, and discharged to stack. As the fumes cooled upon leaving the oven, resinous condensate collected in the hood, fan, and stack, which necessitated frequent shut-down for cleaning. Each interruption of the oven operation involved substantial costs in the way of scrap wire, broken spools, cleaning and re-starting. Therefore, operating procedures which minimize interruptions in operation, result in material savings in manufacturing cost.

* * *

With the disposal system as illustrated, the oven collection hood, mechanical exhaust system, catalyst, and anti-condensate equipment are contained in a single, insulated housing. Electric or gas-fired preheaters are employed primarily for initial starting operations. The oxidized gases leaving the catalyst are usually in the range of 850 deg. — 1000 deg. F. These hot gases pass through an exchanger manifold, located adjacent to the wire slot, and maintain gas temperatures sufficiently high to avoid the formation of condensate. During normal running conditions, sufficient heat is also exchanged to the entrained air and fumes to avoid the need of utilizing external fuel for preheating purposes. Several hundred systems of the type illustrated are currently in use. Automatic controls eliminate the need for manual adjustments. Numerous units have operated continuously throughout a calendar year, without interruptions for inspection or service.

* * *

The cost of modifications to existing wire enamel ovens, as needed to utilize the heat generated within the process, places eco-

nomic limits on self-recovery. However, with the increased emphasis on maintaining within the plant a balanced supply of air to compensate for exhaust volume, external recovery is employed. Heat exchangers are mounted on the stack outlet from disposal systems, as described, for controlled winter heating of factory make-up air.

Catalytic Wire Enameling Ovens

The economic limitations of self-recovery disappear when catalysts are employed as an integral part of new wire enameling oven designs. The higher operating temperatures employed, as compared to other types of baking operations, gives the oven designer a greater range of flexibility in catalyst placement. One typical arrangement for a direct-fired Catalytic recirculating type oven is illustrated in Fig. 4.

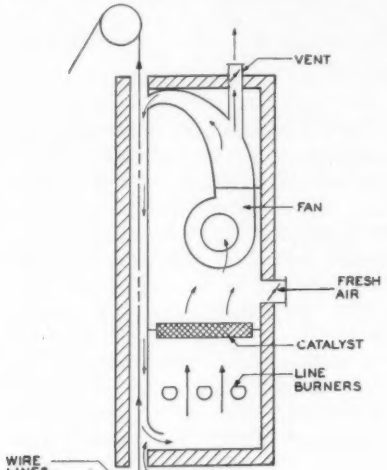


FIGURE 4

As the wires pass through the baking chamber, the released enamel solvents are entrained in the recirculating air and returned to the heating chamber. The combined temperature-rise given to these gases by both the burner and the catalyst is equivalent to the total oven heating demand. At a point between the catalyst location and the inlet of the recirculating fan, the required oven make-up air is introduced and mixed with the hot gases leaving the catalyst. The thermal needs of the make-up air permit (as an example) the maintenance of 500 deg. F. in the baking zone of the oven, with catalyst discharge temperatures in the range of 700 deg. to 800 deg. F.

* * *

For Catalytic wire enameling ovens, it is usually convenient to incorporate decontamination of the oven exhaust gases as a secondary benefit. This is accomplished by venting the oven from the discharge side of the catalyst bed, as shown in the figure.

* * *

Calculations will show that for many wire enameling applications somewhat more heat energy is available from combustion of the solvents than is required to meet the thermal demands of the oven. This is immediately evident when considering a "heavy" wire enameling oven having a calculated heat demand of 350,000 BTU/hr. Such an oven would normally be operating with a solvent load ranging from 3 to 5 GPH, representing available heat of combustion in the range of 360,000 to 600,000 BTU/hr. Obviously, however, the imposition of a slight increase in exhaust volume will raise the thermal demand of the oven so as to equal or exceed the heat released by catalysis . By automatic control of excess ventilation, the oven system can maintain operating temperature with all external fuel supply removed, whenever available heat from volatiles exceeds normal oven heating needs.

Multiple — Zone Catalytic Recovery

The fact that catalysts may require temperatures from 500 deg. F. to 600 deg. F. to consume typical paint solvents, is the source for the occasional misconception that catalysts have applicability only in solvent evaporation processes operating above 500 deg. F. However, the alert oven designer will find adequate means at his disposal for integration of catalysts into the overall oven design for strip drying operations as low as 150 deg. F. Temperature levels in a portion of the heating system can be raised substantially above oven operating temperatures without impairment to precision of temperature control, or operating efficiency. In many cases, heat exchangers can be profitably employed. While higher oven temperatures permit simpler and more flexible design arrangements, Catalytic heat recovery can be applied to all ovens regardless of operating temperature.

* * *

Because of the increasing popularity of multiple zone, continuous strip ovens operating in the range of 350 deg. — 500 deg. F., it is appropriate that a typical flow diagram be presented. This is shown in Fig. 5, with flow arrangement to provide a balanced oven system. Contrary to conventional oven practice in the past, the exhaust fan is located near the work exit end of the oven. Supply and return ducts of forward zones are arranged to provide positive movement toward the exhaust manifold. The obvious advantage of this change is to permit maximum utilization of the released solvents for heating purposes. Multiple zone ovens of this type are employed for the baking of enamels and pigmented finishes on copper, aluminum, steel, and for the baking of coatings and impregnants on papers and textiles.

* * *

As illustrated in the above figure, a flow arrangement may consume as high as 80%-90% of the total volatiles released, depending upon design factors employed. However, condensate in exhaust ducts, and external air pollution, while minimized, are not completely elimin-

(*Please turn to page* 1390)

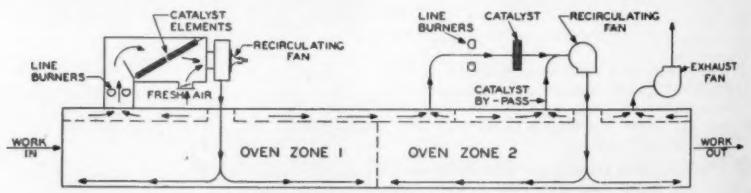


FIGURE 5

Some Metallurgical Factors in the Manufacture of Fine Wire

by

C. M. Jackson
Principal Metallurgist

J. G. Dunleavy
Asst. Division Chief

A. M. Hall
Division Chief

Battelle Memorial Institute
Columbus, Ohio

With the modern emphasis on miniaturization, particularly in the electronics industry, more uses for fine wire are arising every year. By fine wire is meant wire of 0.001 inch, or 1 mil, and less in diameter. Such wire finds application particularly in precision-wound resistors and other instruments where advantage is taken of the increasing resistance of wire with decreasing diameter. Vacuum tubes and other types of electronic equipment also require wire of fine sizes which, not many years ago, was thought to be almost impossible to produce commercially.

* * *

The drawing of wire to these sizes is, at best, a costly, time-consuming process. Moreover, the cost is multiplied every time a strand of wire breaks during drawing and has to be repointed and rethreaded through the multi-die drawing machines. Inasmuch as breaks may occur at almost any diameter, the factors which influence wire drawability should be of interest to wire producers in general, and not only to those concerned with the production of fine wire.

C. M Jackson

J. G. Dunleavy

Mr. Jackson graduated from New York University in 1954 with a degree of Bachelor of Metallurgical Engineering, following which he joined Battelle as Principal Metallurgist in the Alloy Development Division. He is primarily concerned with the development of alloys of precise electrical property combinations and with their processing into fine wire.

While at Battelle he has earned a Master of Science degree in Metallurgical Engineering at Ohio State University.

Mr. Dunleavy is a graduate of the Michigan College of Mines, 1941, from which he holds a degree of Bachelor of Science in Metallurgical Engineering. He became associated with Saginaw Malleable Div., General Motors Corp., the Kankakee Ordnance Works Corp., the Kohler Company as Chief Metallurgist. At Battelle he is chiefly concerned with projects relating to alloy development and the casting and fabrication of ferrous and non-ferrous alloys.

Mr. Hall received degrees of Bachelor of Arts, Bachelor of Science in Metallurgy and Master of Science in Metallurgy from Columbia University in 1935, 1936 and 1937, respectively. Prior to joining Battelle he was a research engineer with the International Nickel Company. As Chief of the Alloy Development Div., he supervises research on the development and fabrication of special-purpose alloys. He is the author or co-author of some 35 technical papers.

This paper was prepared for presentation at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

Previously published information on the production of fine wire has, to a great extent, been concerned with the mechanics of wire drawing, e.g., die design, lubrication, drawing speeds, etc. In this paper, some of the metallurgical factors which influence the drawability of wire to fine sizes are considered.

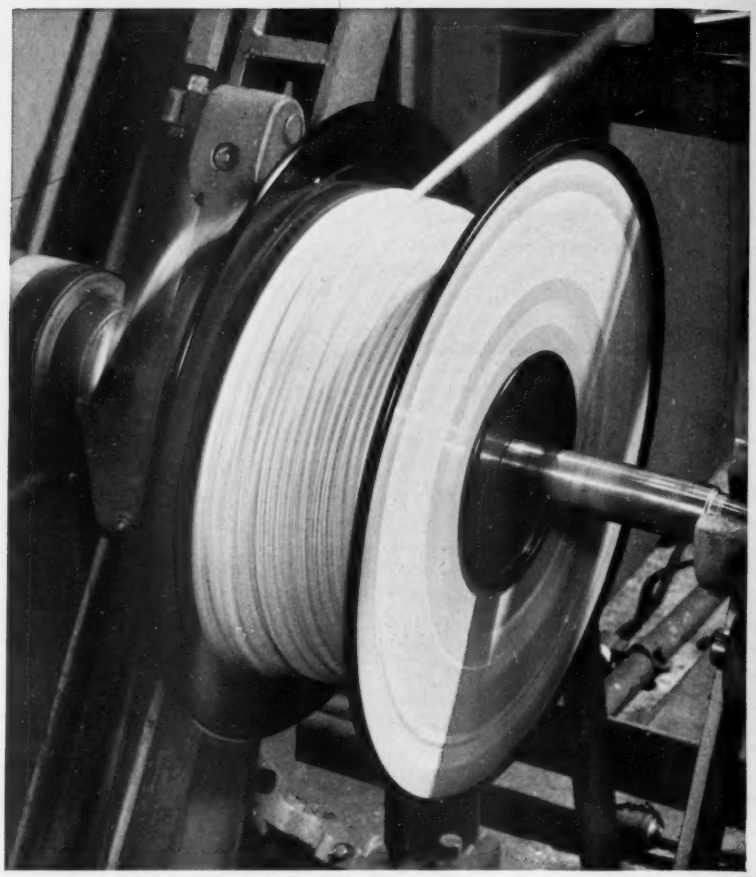
* * *

The metallurgical factors discussed are melting and casting practice, hot-working practice, and annealing and cleaning practice. Although the details pertaining to each factor vary with the metal or alloy being drawn to fine wire, the underlying metallurgical principles are the same. In the discussions, it is assumed that the dies, lubricants, drawing speeds, and other mechanical factors are optimum for the particular metal or alloy being drawn.

Melting And Casting Practice

The melting of the metal and the

A. M. Hall



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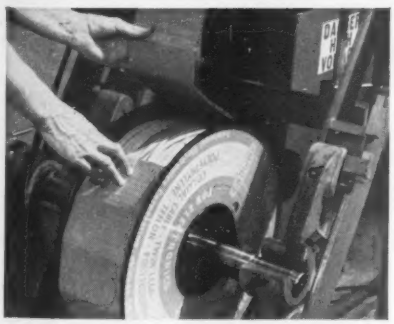


Another fine product, Amphenol cable, ready for shipment. A corrugated strawboard wrap protects cable from abrasion and rough handling in transit. Finished spools of cable are then packed in cartons, or shipped as shown.

J.L.CLARK

casting of it into a shape suitable for subsequent reduction are the first steps in the process of manufacturing fine wire. During this stage of the process, phenomena may occur which decrease drawability to fine sizes and which cannot be altered to any appreciable extent by subsequent operations. The most critical of these are: (1) the formation of nonmetallic inclusions in the metal as a result of the various chemical reactions which take place during melting and freezing, (2) the absorption of gases by the metal during melting, and (3) the production of cavities in the cast metal as it solidifies on being poured into the mold. The severity of the effects expected from these phenomena depend on the melting and casting methods which are used.

* * *

Melting of metals for the production of fine wire may be accomplished in an environment of air, under vacuum, or under an inert gas such as argon or helium. The high-frequency induction furnace and the gas-fired pot furnace are commonly used for air melting. For melting under vacuum or under an inert gas, the high-frequency induction and the cold-hearth consumable-electrode methods are frequently used. If properly carried out, both vacuum melting and melting under an inert gas will produce material of very low gas content and comparatively free of nonmetallic inclusions. Because progressive freezing of the metal from bottom to top is an inherent feature of the consumable-electrode method, this technique produces the soundest cast metal. However, by using good practice, metal that meets commercial fine wire specifications can, in most cases, be produced by air melting. This method is by far the least expensive of the various melting techniques.

Nonmetallic Inclusions

The nonmetallic inclusions present in metals and alloys originate in either of two ways. Some result from entrainment of refractory material from the furnace lining or the ladle, and are sometimes referred to as exogenous inclusions. They are usually complex oxides and silicates. Most inclusions, however, are produced by chemical reactions among the elements present in the molten metal. They are called indigenous inclusions, and comprise oxides, sulfides, and nitrides.

* * *

In air melting, use of high-grade melting stock together with a well lined furnace and ladles, and the proper melting, slagging, deoxidation, and skimming procedures prior to pouring, can leave the metal with a satisfactorily low content of nonmetallic inclusions. In vacuum and inert-atmosphere melting, melting stock of high purity should be used. A photomicrograph of relatively "clean" material is shown in Figure 1. The few inclusions that are present in the material are quite small. This wire drew well to fine sizes.

FIGURE 1. RELATIVELY "CLEAN" MATERIAL

The characteristics of inclusions which influence drawability are number, size, distribution, deformability (roughly indicated by hardness), and shape. In general, the smaller the number of nonmetallic inclusions the better the drawability. However, the influence of the number of inclusions is strongly dependent on other factors. For example, if the inclusions are very small, large numbers may be tolerable. On the other hand, few, if any, large nondeformable inclusions may be allowable. For the most part, the smaller the size of the inclusion particles, the smaller the diameter to which the wire can be drawn. This reaches a limit, however, when the particles are so small that they no longer influence drawability.

* * *

Stringer ("strung-out-in-a-line") or cluster-type distributions detract from drawability more than

do inclusions of the same size that are randomly distributed in the metal. This is because the inclusions in stringer- and cluster-type distributions are more concentrated in space and, in that way, behave in a manner somewhat similar to that of a smaller number of much larger inclusions. Examples of stringer- and cluster-type inclusions are shown in Figures 2 and 3, respectively.

1000X As Polished

FIGURE 2. STRINGER-TYPE DISTRIBUTION OF NONMETALLIC INCLUSIONS

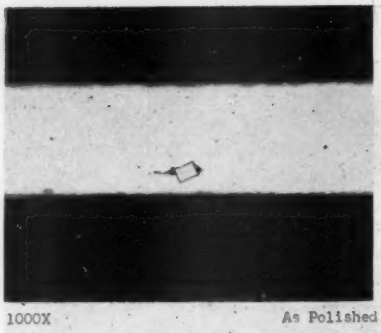
1000X As Polished

FIGURE 3. CLUSTER-TYPE DISTRIBUTION OF NONMETALLIC INCLUSIONS

The deformability of the inclusions is of prime importance, especially when the inclusions are large. Many sulfide-type inclusions are relatively soft and ductile and, consequently, may not interfere with drawing quality. At the other extreme are nitrides and carbonitrides which are hard and nondeformable. Such inclusions as these are apt to impair drawability.

* * *

An indication of the influence of the shape of nonmetallic inclusions on drawability is suggested in Figures 4 and 5. Figure 4 shows a very angular titanium carbonitride inclusion with a diagonal diameter of 0.25 mils in a strand of 1.1-mil wire. If an attempt were made to draw this wire to a finer diameter,



1000X As Polished

FIGURE 4. LARGE TITANIUM CARBONITRIDE INCLUSION IN 1.1-MIL WIRE

1000X As Polished

FIGURE 5. LARGE SILICATE INCLUSION

the sharp corners of the extremely hard carbonitride particle could act as stress raisers, resulting in the initiation and propagation of a transverse crack with subsequent breakage of the wire.

* * *

Figure 5 shows another type of hard nonmetallic inclusion, a glassy silicate. This type of inclusion has rounded rather than sharp corners. The silicate shown in Figure 5 is 0.8 mils across. The silicate, being quite hard, does not change shape during drawing. Because of its smooth outline, the metal flows around it, as water bypasses a rock in a stream. As the wire is drawn and its diameter approaches that of the inclusion, a point is reached where insufficient metal remains to support the drawing force and the wire breaks.

Gaseous Impurities

Molten metal tends to absorb gases from the environment in which it is melted. Some gases appear to be absorbed by direct solution in the metal. In this way, for example, nitrogen may be absorbed from the atmosphere by molten nickel-base, iron-base, and iron-chromium-nickel alloys. Gases are also introduced into the metal by chemical reactions. The metal may react with atmospheric water vapor or moisture in the refractories with which it comes in contact, producing metal oxide and hydrogen; whereupon, both may dissolve in the metal. Oxygen may perhaps be absorbed directly from the atmosphere, or it may form oxides on the surface of the bath which then dissolve in the metal.

* * *

The presence of gaseous elements dissolved in the metal would probably not adversely affect metal quality, so far as wire drawing is concerned, if those elements remained dissolved. However, they tend to precipitate from solution when the metal freezes. They may also react with other elements, especially during freezing, and form undesirable compounds. Oxygen may combine with metallic elements present to form oxide-type nonmetallic inclusions. When the hydrogen content of the melt is high enough, this element may combine with dissolved oxygen to form water vapor which is insoluble and, hence, is rejected from the metal. If this occurs during freezing, gas pockets are produced in the solidified metal. In some instances, dissolved carbon and oxygen will combine to form carbon monoxide and carbon dioxide which produce holes in the frozen metal in a manner somewhat similar to that of water vapor.

* * *

Sometimes gas pockets and holes weld and disappear during hot working of the cast ingots to billets. However, some do not. Although the resultant defects may not be visible even with a microscope, defects of this type may contribute to failure of fine wire.

* * *

In addition to their effect on drawability, gaseous impurities may also affect the quality of finished fine wire products. One example of this is the evolution of gas (usually, hydrogen) during enameling, resulting in breaks in the enamel coating. Another example is that of wire sealed in glass and heated to elevated temperatures. Any bubbles formed in the

(*Please turn to page* 1396)

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Product Development Metallurgist
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453 Main Street
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THE WIRE ASSOCIATION

453 MAIN STREET
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Titles and connections of Past Presidents are those at the time each held office.

The Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

There are separate divisions for all the various major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

ACTIVITIES

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Production simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

Greetings:

To the hundreds of wire men who will gather in Cleveland for the 1959 Annual Convention of The Wire Association, I would like to extend, on behalf of the Officers and Directors, greetings and a most cordial welcome.

In the matter of the technical sessions, some very basic changes in the format of the program will be noted. We have planned three simultaneous meetings for the Ferrous, Non-Ferrous (bare wire), and Electric Wire and Cable Divisions respectively, with full programs for each group.

The Annual Luncheon and the Smoker-Dinner have been discontinued and in their place we have arranged an Annual Dinner for members and their ladies for Wednesday evening, at which time we have been fortunate in securing an outstanding speaker who will address the Association on a timely topic of general interest. The Mordica Memorial Lecture, which was formerly a feature of the Annual Luncheon, will now be given at the opening joint session on Monday afternoon. Twenty-five-year certificates will be presented at the same meeting and this first session will conclude with several papers of general interest.

Your Directors trust that these changes will meet with the approval of all members and will welcome your reaction to the modifications in the program. An opportunity to voice your opinions will be provided by the Annual Meeting of the Association on Wednesday, October 14, at 4 p.m., at which time our plans for the future of The Wire Association may be heard and discussed.

ALLAN B. DOVE

The changes which have been made in the program this year are the first in a considerable period. They may not constitute the best possible arrangement, but the Directors, whose task it is to plan and conduct the Association's affairs, can carry out their appointed duties successfully only if they have your support, opinions and co-operation.

Welcome to Cleveland!

Allan B. Dove, President
THE WIRE ASSOCIATION

THE ANNUAL CONVENTION OF THE WIRE ASSOCIATION

STATLER-HILTON HOTEL, CLEVELAND, OHIO, MONDAY THROUGH THURSDAY
OCTOBER 12-15, 1959

The Wire Association's Headquarters at The Statler-Hilton Hotel
will be open each evening from Sunday, October 11th, except Wednesday night.
YOU ARE CORDIALLY INVITED TO CALL AND MEET OTHER WIRE INDUSTRY MEN

THERE WILL BE A REGISTRATION FEE OF $18.00 FOR MEMBERS AND $20.00 FOR NON-MEMBERS, INCLUDING AN ANNUAL DINNER TICKET, FOR ALL THOSE ATTENDING THE TECHNICAL SESSIONS AND MEETINGS. PLEASE HAVE YOUR ASSOCIATION MEMBERSHIP CARD WITH YOU AND SHOW IT WHEN REGISTERING.

ADMISSION WILL BE BY BADGE ONLY—PLEASE WEAR IT.

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General Cable Corp.

Technical papers are preprinted in the October issue of Wire and Wire Products insofar as possible. Titles to papers accepted will be given to The Wire Association and duly copyrighted at the time of publication. All papers presented at the Convention by members of The Wire Association are eligible for consideration for the Annual Medal Award and other awards made each year for outstanding excellence.

All wire mill men and wire mill suppliers are invited to attend this convention, see how the Association functions and participate in the activities. Simultaneous technical sessions for Ferrous, Non-Ferrous and Electric Wire & Cable Divisions are held.

REGISTRATION AND TECHNICAL MEETING ROOMS ARE ALL ON THE SAME FLOOR. Please be prompt in your arrival for the technical sessions. Those with rooms for entertainment are requested NOT TO KEEP THEM OPEN during the technical sessions.

MONDAY, OCTOBER 12th

9:00 A.M.
REGISTRATION

10:00 A.M.
DIRECTORS' MEETING

12:30 P.M.
PROGRAM COMMITTEE LUNCHEON

THE WIRE ASSOCIATION

CONVENTION PROGRAM

MONDAY, OCTOBER 12

9:00 A.M. Registration Desk opens
10:00 A.M. Meeting of the Board of Directors of The Wire Association
12:30 P.M. Directors' Luncheon for Program Participants. Address of Welcome by President Allan B. Dove

JOINT FERROUS AND NON-FERROUS TECHNICAL SESSION

MODERATOR

Allan B. Dove, Development Metallurgist, Steel Company of Canada Ltd.

2:00 P.M. Address of Welcome by Allan B. Dove, President of The Wire Association.

PRESENTATION OF THE TWENTY-FIVE YEAR CERTIFICATES

THE MORDICA MEMORIAL LECTURE

"The Manufacture of Precision Cold Drawn Shaped Wire" by John Rigby, Managing Director, John Rigby & Sons Ltd., Low Moor, Bradford, England.

PAPER: "Manufacture of Wire Products — Oven-racks, Baskets, and Refrigerator Shelves," by F. B. Thacker, Bauer Bros. Co., Springfield, Ohio.

PAPER: "The Impact of Modernization in Wire Weaving," by T. L. Stilwell, Warner-Swasey Co., Cleveland, Ohio.

MOTION PICTURE: "Building of The Mackinac Bridge" —Courtesy of the American Steel & Wire Div. of the United States Steel Corp.

TUESDAY, OCTOBER 13 — 9:00 A.M. FERROUS DIVISION TECHNICAL SESSION

MODERATOR

Stewart S. Gray, Asst. Vice Pres., Union Wire Rope Corp., Kansas City, Mo.

PAPER: "A New Method for Fatigue Tests on Steel Wires and Wire Ropes and the Viewpoints Opened by the Results Obtained" — by Denis van de Moortel, Technical Chief Manager, United Rope Works, Leiden, Holland.

PAPER: "Air Force Tow Members" — by Jack E. Tiede, Supervisory Eng., Air Force Proving Center, Elgin Air Force Base, Florida.

PAPER: "High Temperature Tests of Aircraft Control Cable" — by Howard J. Godfrey, Asst. Chief Devel. Eng., John A. Roebling's Sons Corp., Trenton, N. J.

PAPER: "The Rolling of Round Wire into Flats and Rectangles" — by Alexander F. Sperduti, Asst. Chief Eng., The Fenn Manufacturing Co., Newington, Conn.

TUESDAY, OCTOBER 13 — 2:00 P.M. FERROUS DIVISION TECHNICAL SESSION

MODERATOR

Rudolf H. Hertzog, Met. Eng., Wire Mills Div., John A. Roebling's Sons Corp., Trenton, N. J.

PAPER: "ABC of Better Lubrication and Cooling in Steel Wire Drawing" — by J. G. Wistreich, Head, Mechanical Working Div., British Iron & Steel Research Assn., Sheffield, England.

PAPER: "Straightline Non-Slip Wire Drawing with Electrical Equipment Using Alternating Current" — by Robert H. Geiss, Manager, Herborn Machinery Corp., Hackensack, N. J.

PAPER: "The Drawing and Handling of Long Production Run Wire Coils" — by Uno V. Johnson, Supt., Rod and Wire Div., Detroit Steel Corp., Portsmouth, Ohio.

FILM: "The Packaging and Handling of Coiled Wire at Detroit Steel Corporation" — by J. F. Beckman, Asst. Vice Pres., Signode Steel Strapping Co., Chicago, Ill.

FILM: "Use of Wire in the Cold and Hot Forging Industries" — by Dale Walcutt, The National Machinery Co., Tiffin, Ohio.

NON-FERROUS DIVISION TECHNICAL SESSION
BARE WIRE SECTION

TUESDAY, OCTOBER 13 — 9:00 A.M. MODERATOR

David M. Schmid, Pres., Techalloy Company, Inc., Rahns, Pa.

PAPER: "Trends, Copper and Copper Alloy Rod and Wire" — by Richard J. Christine, Metallurgical Mgr., Torrington Div., The American Brass Co., Torrington, Conn.

PAPER: "A Substitute for Silicon Bronze—Its Fabrication and Properties" — by Roger Martin, Chief Met., Triangle Conduit & Cable Co., New Brunswick, N. J.

PAPER: "Recent Developments in Aluminum Alloy Wire" — by Charles L. Kessler, Chief Works Met., Aluminum Company of America, Massena, N. Y.

TUESDAY, OCTOBER 13 — 2:00 P.M. MODERATOR

Henry McConnell, Wire Plant Mgr., Sylvania Electric Products, Inc., Warren, Pa.

PAPER: "Some Metallurgical Factors in the Manufacture of Fine Wire" — by C. M. Jackson, J. G. Dunleavy & A. M. Hall, Alloy Development Div., Battelle Memorial Institute, Columbus, Ohio.

PAPER: "Titanium Zirconium Wire Drawing" — by Robert Knight, Sales Mgr., Johnston & Funk Metallurgical Co., Wooster, Ohio.

PAPER: "Applications of Photoelastic Coatings to Measurements in Wire Manufacture" — by Dr. Felix Zandman and Frank G. Tatnall, Tatnall Measuring Systems Co., Phoenixville, Pa.

NON-FERROUS DIVISION TECHNICAL SESSION
ELECTRIC WIRE & CABLE SECTION

TUESDAY, OCTOBER 13 — 9:00 A.M. MODERATOR

James E. Flood, Technical Director, Plastic Wire & Cable Corp., Jewett City, Conn.

PAPER: "Facilities for Wire Irradiation with an Electron Beam Generator" — by R. P. Skundberg, X-Ray Dept., General Electric Co., Milwaukee, Wisc.

PAPER: "The Use of Irradiated Polyethylene in Wire and Cable" — by A. N. Towne, Specialist-Market Devel., Insulating Materials Dept., General Electric Co., Schenectady, N. Y.

PAPER: "Chemically Cross-Linked Polyethylene" — by Michael M. Suba, Product Sales Mgr., Union Carbide Plastics Co., New York, N. Y.

TUESDAY, OCTOBER 13 — 2:00 P.M. MODERATOR

Urbain J. H. Malo, Technical Director, Narragansett Wire Co., Pawtucket, R. I.

PAPER: "Thin Metal Strips for Sheathing Telephone Communication Wire" — by H. N. Padowicz, Senior Staff Engineer, Cable Development, Western Electric Co., Kearny, N. J.

PAPER: "Bonding Characteristics of Insulating Varnishes and Wire Enameling Systems" — by Donald L. McClenahan, Chief Elec. Eng., Schenectady Varnish Co., Schenectady, N. Y.

PAPER: "Catalyst Applications for Continuous Strip Ovens" — by Richard J. Ruff, President, Catalytic Combustion Corp., Detroit, Mich.

WEDNESDAY, OCTOBER 14 — 9:00 A.M. FERROUS DIVISION TECHNICAL SESSION

MODERATOR

Carleton W. Garrett, Met. Eng., Graham Research Labs., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

PAPER: "The Manufacture and Properties of Basic Oxygen Steel for Wire Products" — by H. B. Emerick, Dir. of Technical Services, and Sol Kreisberg, Metallurgical Supvr., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

PAPER: "High speed Rod Rolling" — by E. L. Chamberlain, Div. Supt., American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio.

PAPER: "Quality Control in an Alloy Steel Bar Mill" — by T. P. Davis, Statistical Quality Control Eng., Allegheny Ludlum Steel Corp., Watervliet, N. Y.

PAPER: "Work Sampling in a Nail Mill" — by J. T. Weir, Statistical Eng., American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio.

NON-FERROUS DIVISION TECHNICAL SESSION
BARE WIRE SECTION

WEDNESDAY, OCTOBER 14 — 9:00 A.M.

MODERATOR

Bruce W. Gonser, Technical Director, Battelle Memorial Institute, Columbus, Ohio

PAPER: "Glass Sealing Wires" by E. G. Slick, Div. Metallurgist, Sylvania Electric Products, Inc., Warren, Pa.

PAPER: "Some Age Hardenable Copper-Base Alloys for Wire Products" — by Donald E. Pardon, Design & Devel. Eng., Chase Brass & Copper Co., Waterbury, Conn.

PAPER: "Copper's Future" by R. P. Koenig, President, Cerro de Pasco Corp., New York, N. Y.

PAPER: "Vacuum Annealing of Wire" — by Messrs. Fritz & Michael, Ofenbau Fritz G.m.b.H., Hagen, Germany.

PAPER: "Engineering Wire Tensions" — by Erwin J. Saxl, Pres., Tensitron, Inc. Harvard, Mass.

NON-FERROUS DIVISION TECHNICAL SESSION
ELECTRIC WIRE & CABLE SECTION

WEDNESDAY, OCTOBER 14 — 9:00 A.M.

MODERATOR

Philip H. Snyder, Plant Mgr., Electric Auto-Lite Co., Hazleton, Pa.

PAPER: "Production and Laboratory Control of High Quality PVC Compounds for Wire and Cable Insulations and Jackets" — by Q. R. Ball, Asst. Supt., Cable Engineering Labs., Wire & Cable Div., Northern Electric Co. Ltd., Lachine, Que., Canada.

PAPER: "Small Diameter Power and Control Cables" — by Maurice Gilbert, Senior Electrical Eng., E. I. du Pont de Nemours & Co., Wilmington, Del.

PAPER: "An Improved Aging Method of Vinyl Insulation Compounds in a Modified Testing Oven" — by Allen E. Polson, Apex Tire & Rubber Co., Pawtucket, R. I.

WEDNESDAY, OCTOBER 14 — 2:00 P.M. MEETING—ELECTRIC WIRE AND CABLE COMMITTEE

4:00 P.M. ANNUAL MEETING OF THE WIRE ASSOCIATION

WEDNESDAY, OCTOBER 14 — 6:15 to 7:00 P.M. — HOSPITALITY HOUR

7:00 P.M. — THE ANNUAL BANQUET

PRESENTATION OF AWARDS FOR 1958 PAPERS

Following the dinner, the group will be addressed by an eminent scientist, DR. JASON J. NASSAU, one of America's foremost astronomers, professor and head of the Department of Astronomy, Case Institute of Technology, Cleveland. Dr. Nassau will discuss "Life in other Worlds".

THURSDAY, OCTOBER 15 — 9:00 A.M.

PLANT INSPECTION TOUR

Busses will leave the Statler-Hilton Hotel to visit the Cuyahoga Works of the American Steel & Wire Division of United States Steel Corporation. All persons taking the tour must go by bus — no private cars may be used.

PLEASE WEAR YOUR BADGES AND HAVE YOUR BUS TICKET WITH YOU.

Convention papers not printed in the October issue of Wire And Wire Products will be printed in November and December.

The Convention proceedings, the Story of the Convention and the Mordica Memorial Lecture will be published in the January, 1960, issue.

THE MORDICA MEMORIAL LECTURE

An invitation to deliver the Mordica Memorial Lecture is considered the highest honor within the power of the Board of Directors of The Wire Association to bestow upon a member.

The lecturer is selected each year by the Board of Past Presidents on the basis of outstanding contributions to th wire indusry.

The 1959 Lecture will be delivered by JOHN RIGBY, Managing Director of John Rigby & Sons Ltd., England, whose lecture is on the subject of "THE MANUFACTURE OF PRECISION COLD DRAWN SHAPED WIRE."

THE ANNUAL MEDAL AWARDS

Every year a bronze Medal is presented to an author in each of the Association's divisions—Ferrous and Non-Ferrous—for those papers that come nearest to the requirements set forth herein. Honorable mention Certificates are also awarded. These awards are presented during the Annual Convention of The Wire Association. The medals and certificates are accompanied by cash awards of $100.00 and $50.00, respectively.

* * *

Consideration for such awards is not limited to papers presented at Association meetings, but to all papers submitted by members as a contribution to The Wire Association and published in WIRE AND WIRE PRODUCTS.

* * *

All papers submitted become the property of The Wire Association and are assigned to WIRE AND WIRE PRODUCTS for copyrighting and exclusive publication.

* * *

Awards, you will note, are a recognition of a definite contribution to the advancement of the interests of the Wire Industry.

* * *

Selection of papers for awards rests in the hands of the Association's Committee on Awards, which is headed by a director of The Wire Association.

REQUIREMENTS FOR CONSIDERATION OF PAPERS

The first consideration of eligibility is that the author or authors must be Association members. A second is that it must be a contribution to the Association or to WIRE AND WIRE PRODUCTS, as articles for which the magazine has paid an honorarium cannot be considered. A third is that any paper that has been previously presented before another society or published in another magazine cannot be taken under advisement for awards.

* * *

JUDGING PAPERS

Papers eligible for awards are judged by the Oxford System, which is considered the best one so far devised for the impersonal determination of the worthwhileness of papers. Consideration is given to the following points, among others:

1. Value of the paper to The Wire Association's members as a whole.
2. Does it contain new information that has not been published hitherto, or is it merely a restatement of research material?
3. Does it constitute an advancement in knowledge by clarification of past information?
4. Does it provide a re-assessment of known facts in such manner as to be readily understood by the industry as a whole?
5. Are the claims in the paper factually supported with definite, impartial test data and established experience?
6. Is the paper valuable as a reference work?

All members of The Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association or the Regional Meetings.

THE TWENTY-FIVE YEAR CERTIFICATES

These certificates of The Wire Association are presented each year by the Board of Directors to those who have been members continuously for 25 years. The 1959 recipients are:

DAVID DWIGHT BUCHANAN
Johnstown, Pa.

FREDERICK W. GAINES III.,
Gen. Mgr.
Ajax Mfg. Co., Cleveland, Ohio

JOSEPH A. HAGUE
Asst. Gen. Mgr., Sales
Pittsburgh Steel Co., Pittsburgh, Pa.

CHARLES E. HUGHES
Destin, Fla.

DAVID B. IRELAND, SR.
Sec.-Treas.
Wolverine Bolt Co., Detroit, Mich.

JAMES F. KAVANAUGH
Supvr., Wire Div.
C. O. Jelliff Mfg. Co., Southport, Conn.

EUGENE ROTH
Pres.
Eugene Roth Inc., White Plains, N. Y.

GEOFFREY K. RYLANDS
Man. Dir.
Rylands Bros. Ltd., Warrington, Eng.

EMERSON SPEAR
Vice Pres.
Pacific Wire Rope Co., Los Angeles, Cal.

ALEXANDER B. STIRLING
Secy.
Greening Wire Co. Ltd.,
Warrington, Eng.

CURTIS VOIGTLANDER
Consultant
Erlton, N. J.

WILLIAM J. WIND,
Sr. Vice Pres.
Wilbur B. Driver Co., Newark, N.J.

THE ELECTRIC WIRE & CABLE SECTION OF
THE WIRE ASSOCIATION

The Association has been interested in and has had electric wire and cable men as members throughout its 30-year existence. During the period this membership has grown steadily and the service of the Association has developed correspondingly. It had reached a point where a special section to serve their interests became necessary and so this Section was organized in response to calls to fill the need for a common meeting-ground for production men.

The purpose of the Section is to disseminate the technical and practical information required for the production of Electric Wire and Cable. Men in the mills concerned with production problems, working with and through the Committee may now hold regional meetings devoted wholly to their interests and have programs during the Annual Convention concerned only with their problems.

The Committee began to function in 1958 and the full impact and value to the industry became fully effective at the Spring meeting of the Section at Boston and at this, the 1959 Annual Convention.

The Committee

The Electric Wire and Cable Section Committee, comprised of nineteen members, is listed below:

Clement C. Lawson (Chairman)
Plant Facilities Engineer
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

Harold W. Adams, Prod. Supvr.
Cable Div. Reynolds Metals Co.
2500 So. 3rd St.
Louisville 1, Ky.

David Barr, Plant Eng.
National Electric Div.
H. K. Porter Co.
338 14th Street
Ambridge, Pa.

Grover W. Brown, Mgr., Machinery Development
The Okonite Co.
Passaic. N. J.

G. E. Forsberg, Vice-President
Surprenant Manufacturing Co.
172 Sterling St.
Clinton, Mass.

Charles M. Fredrickson, Tech. Dir.
Southern Electrical Corp.
P. O. Box 989, Chattanooga, Tenn.

James S. Higgins, Plant Eng.
Walker Brothers, Copper Div.
Conshohocken, Pa.

R. W. Higginbottom, Chief Cable Eng.
Triangle Conduit & Cable Co.
P. O. Box 711
New Brunswick, N. J.

Alexander A. Kerr, Supt.—Prodn.
Electrical Wire Div.
John A. Roebling's Sons Corp.
Trenton 2, N. J.

C. L. Kessler, Chf. Works Met.
Aluminum Company of America
Massena, N. Y.

Urbain J. H. Malo, Technical Dir.
Narragansett Wire Co.
341 Pawtucket Ave.
Pawtucket, R. I.

W. R. Moyers, Chief Eng.
Wire Engineering Dept.
Western Electric Co.
P. O. Station B
Buffalo 7, N. Y.

J. C. Murray, Jr., Vice-President
Crescent Insulated Wire & Cable Co.
319 N. Olden Ave.
Trenton 5, N. J.

Sidney Rolle, Cons. Met. Eng.
32 Snowden Lane
Princeton, N. J.

D. M. Schmid, President
Techalloy Co., Inc.
Rahns, Pa.

Philip H. Snyder, Plant Mgr.
Wire and Cable Div.
The Electric Auto-Lite Co.
601 Poplar St.
Hazelton, Pa.

H. S. Spaulding, Tech. Supt.
Kaiser Aluminum & Chemical Corp.
P. O. Box 671, Newark, Ohio

Roger T. Stafford, Project Engineer
Kennecott Wire & Cable Co.
Phillipsdale (Rumford 16), R. I.

Marshall V. Yokelson, Chief Met.
General Cable Corp.
Bayonne, N. J.

Details concerning the activities of the Section will be reported as they develop.

THE WIRE ASSOCIATION

RICHARD E. BROWN, *Executive Secretary*

453 MAIN STREET **STAMFORD, CONN.**

Straightline Non-Slip Wire Drawing With Electrical Equipment Using Alternating Current

by Robert H. Geiss, Manager
Herborn Machinery Corporation
Hackensack, New Jersey

A paper prepared for presentation at the Annual Convention of The Wire Association in Cleveland, Ohio, on October 13, 1959.

It is indeed a privilege to address this distinguished group of wire people, in an effort to bring before you the description of a wire drawing machine incorporating new principles of electrical controls essential in the production of high quality steel wires, especially high carbon wires.

* * *

These principles are embodied in machines manufactured by **Herborn Maschinenfabrik,** Herborn, Germany, who, besides originating the method of drawing wire wet by the submerged system, has been largely responsible for powering multi-draft dry-drawing machines with individual motors and installing mechanical two and three speed gear boxes in order to provide up to six different speeds for each unit for the drawing of low and medium carbon steel wires. Now the company has pioneered a new method of drawing high carbon steel wire, such as music and similar grades of steel wires.

* * *

High carbon wires are commonly drawn in a straight line directly from block to block, utilizing direct current equipment to eliminate slip. This type of installation produces excellent results, but it requires a great deal of cumbersome, expensive equipment. Considering the requirements for wire drawing equipment in Europe, which of course are different from those prevailing in the United States, Herborn decided upon a new approach to this problem, utilizing slip-ring motors operating on alternating current, and it is the purpose of this paper to acquaint you with the results of their efforts, culminating in their new wire drawing machine, Model GI A.

* * *

The machine which I shall discuss, is an 8-draft high carbon steel wire set-up, drawing rods from a little heavier than 3/8" diameter to finished sizes ranging from approximately .200" to .120" diameter, at speeds of 300, 700, and 1000 feet per minute. Each block is a completely self contained unit with its own motor, controls, water and aircooling systems, with foot-pedal controls for inching, and pushbutton control for continuous operation. A pulling force of approximately 8,800 lbs. is provided for each block, and while the machine is essentially designed to draw high carbon wire, it is, of course, also possible to draw medium and low carbon wire as well as non-ferrous wire of the appropriate diameters.

* * *

Eight of these blocks have been combined into one unit, each block being provided with proper gears to equip the machine with the desired basic speeds for a specific reduction in area, usually 20 to 25%.

* * *

Separate mechanical gear boxes provide three different basic speeds.

* * *

Since the machine is supposed to draw wire without slip from block to block, additional controls for the motors had to be provided. As already stated, the machine is driven by A/C slip-ring motors. A method had to be devised to adapt the motor output closely to the actual load required for each block, since slip-ring motors do not react properly when under insufficient load. For this reason, the motors are equipped with a power selector switch, providing 4 different horsepower ratings, at constant torque, in this case, 25, 30, 35 and 40 HP. Looking at the loadmeter, the operator can select the proper rating, so that full load characteristics are created, even in cases where the rated motor capacity is not fully utilized. In addition, the speed of each motor can be reduced up to 30% of the rated speed in order to synchronize the speed of the blocks in relation to each other. This downward reduction in motor speeds is achieved by means of rheostat controlled in 15 steps by a handwheel mounted under each die box. Each of the 15 steps will provide a 2% reduction in motor speeds up to a maximum of 30%.

* * *

In this connection it is also to be considered that slip-ring motors have a tendency to show compensating characteristics, that is to say, they tend automatically to adjust to changing load conditions within certain limits, so that it can be stated that within the scope outlined before, it is possible to achieve practically stepless control of the speeds. By controlling the speeds of the motors, it is also possible to draw wire up to 5% above as well as 5% below the basic reductions built into the machine.

* * *

As an illustration, I would like to give you some figures based on a

(*Please turn to page* 1380)

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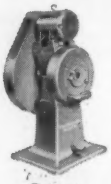
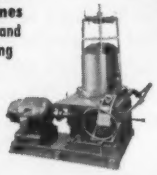
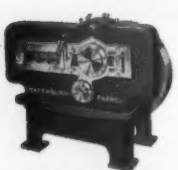


Rotary Swagers



Vertical Bull Blocks



Horizontal Swagers

Wire Shaving Bench

Continuous Tandem Wire Drawing Machines

Horizontal Bull Blocks

- BULL BLOCKS
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- HAND SWAGERS
- HORIZONTAL SWAGERS
- ROLL POINTING MACHINES
- ROTARY SWAGERS
- SLEEVE WIRE DRAWING MACHINES
- SPOOLERS
- STRING-UP MACHINES
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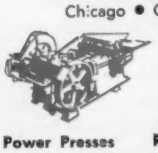
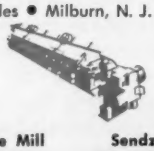
Cold Heading Machinery



Power Presses

Rolling Mill Machinery



Wire Mill Equipment

Sendzimir Mills and Other Special Machinery

Know Your Stuff!

Wire manufacture today is a highly specialized business, requiring technical knowledge of a high order as to chemistry, metallurgy, electronics, mathematics and mechanics.

* * *

That this is not new, in spite of the vast technological advances made in the processing of wire, is evidenced by a thirteenth century ordinance of the City of Paris, which **Maurice Bonzel** in his book, "Steel Wire" (published in 1934), quotes as follows:

"Whosoever would enter the wire business, it is required of him that he know the trade, and that he have what it takes."

* * *

Sometimes, with the best of equipment and the best of technical know-how, we hear reference to "rejects" — a nasty word that customers occasionally apply to some of our carefully controlled output.

* * *

It is an old problem. In the town records of Coventry, England, headquarters of the Wire Workers Guild, on September 14, 1435, is recorded the complaint of an irate wire customer who states:

"Sir, I had of you late bad wire. Sir, amend your hand or in faith I will not buy more of you."

* * *

The Guild membership was comprised of rod makers, annealers, coarse wire drawers and fine wire drawers. Verity, standards and knowledge have increased, though as **Robert Burns** said, "The best laid schemes o' mice an' men gang aft a-gley."

Elongation Tests

All kinds of tests are made on wire. The measurement of elongation as a part of tensile tests has long been considered an index of ductility, although the most ductile wires are not always those that show the greatest elongation.

* * *

It has been found that elongation in the vicinity of the fracture is many times that of a short distance from the fracture. There appears to be no particular physical meaning to the stress (force applied in terms of psi) at which uniform elongation stops and necking elongation starts.

* * *

For this reason the elongation should be divided into two-parts—uniform and necking. Uniform takes place between zero load and maximum load. Necking takes place between maximum load and fracture, and this latter may be considered a more reliable measure of ductility. Torsion, bend and wrap tests are also good ductility indices, which closely correspond to the results of necking elongation.

Readers are invited to send us how-to-do-it items for this department. For each item received that is published we will pay contributors $10.00. Your cooperation will be appreciated by us and our many readers. May we hear from you?

Crystallography and Diamond Die Life

Diamond wire drawing die performance can be greatly improved by giving consideration to the crystal structure of the diamond prior to drilling.

* * *

One specialty wire mill, in which tough metals have to be drawn to exacting tolerances, thought that its diamond dies were not giving what they considered satisfactory life. They acquired X-ray diffraction equipment to study the crystal orientation of the stones before having them drilled.

* * *

By drilling with respect to crystal structure instead of just starting the hole on the flattest surface of the diamond as it comes from the mine, die life was increased several times and more exact tolerances achieved. The same procedure has been found valuable in the manufacture of fine diamond cutting tools.

Tip for Hot-Dip Galvanizers

It is well known that bath temperature bears a direct relation to the attack of molten zinc on the steel used in pot construction.

* * *

At temperatures up to 860°F very little attack has been noted. Above 860°F and up to 875 or 880°F the action increases considerably. From 880 to 900°F it becomes more violent and above 900°F it is so marked that pot life is shortened, as the plate literally dissolves and soon arrives at the failure point.

* * *

Too high temperatures also create an undue accumulation of zinc-iron dross, which decreases the zinc, contaminates the bath and, since there is little heat transfer, builds up the bath temperature progressively.

Dies and Lubricants In Drawing Aluminum

In drawing aluminum wire, finishing speeds of 500 to 5000 feet per minute are common practice, depending on wire size, speed being more or less a function of final diameter.

* * *

Tungsten carbide dies are used for drawing wire down to .050″ and diamond dies for the finer gages. Bearing lands are usually 20% to 50% of the die hole diameter and approach angles of approximately 24° are used for wire of .257″ or larger, and 16° for diameters less than this.

* * *

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Wire Kinks

Most aluminum wire is drawn with a petroleum base oil as a lubricant. For coarse and intermediate sizes, oil with a viscosity of 2500 S.S.U. at 100°F is circulated over the dies. For fine sizes, an oil with a viscosity of 100 S.S.U. or 100°F is employed. Many mills use an extreme pressure additive.

* * *

European practice favors the use of emulsions over oils because of the high specific heat of water in comparison with oil. There, however, drawing speeds are considerably less than in this country. It might also be mentioned that a number of proprietary compounds have been developed by the lubricant manufacturers that perform satisfactorily. These include both dry and wet types, for coarse and fine wires respectively.

* * *

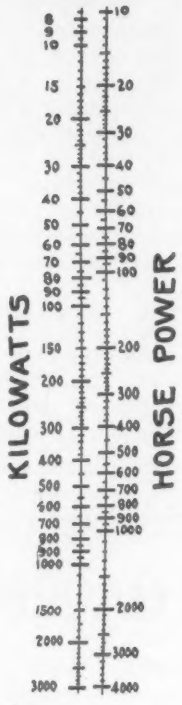
Even though die pressures are relatively low, great internal heat is generated at high drawing speeds and for this reason water miscible oil compounds and special coating measures are desirable for fine wire.

How Many Horse Power? How Many Kilowatts?

The question often comes up as to the relationship between horse power and kilowatts. The exact figure is: one kilowatt is equal to 1.3411 horse power.

* * *

That is the figure to use for exact computing. But most of us don't like longhand figuring, and most of the time an absolutely accurate figure is not essential. So this writer prepared the accompanying simple scale. Just glance across from one scale to the other—and there's the answer. You read the scales in the same way that you read an ordinary



thermometer.

* * *

For example, how many kilowatts in 100 h.p.? Find the 100 in the h.p. column and glance over to the kw column and there is the answer—75 kilowatts. For 10 h.p. you can see the same figure if you wish by knocking off one cipher and the answer will be 7.5 kw. Or, in the same way 1 h.p. equals 0.75 kw.

* * *

Now do this one: How many h.p. in 1500 kw? The answer, as the scale shows, is 2,000 h.p.

Scale Removal

While the bulk of steel rod is acid pickled, there is growing interest in mechanical descaling, equipment for which falls into two broad categories: shot-blasting and rod flexing.

The proponents of all processes have perfectly sound and reasonable facts to back their convictions. Acid pickling is time-proven, but has its drawbacks. It is messy, complicated, time-consuming, fume-generating, and presents the problem of acid embrittlement, especially in the higher carbon ranges, and that of waste pickle liquor disposal.

* * *

Simplest of the methods is the scale breaking type, that utilizes two or more sheaves arranged in different planes, over which the rod is flexed. After this operation the rod passes through a set of rotating wire brushes and an air stream to remove scale particles and dust, usually entering the rod breakdown machine directly after cleaning. Such machines are widely used in Europe and are growing in favor here.

* * *

The perfection of shot blasting techniques has brought this process into prominence in the last two years. Shot blasting does a thorough job. While the first cost of equipment is higher, it is less than that for a pickling line and cleaning costs are said to be lower.

* * *

Mechanical descaling produces a somewhat less smooth surface than acid pickling, but the advantage of this is the elimination of liming and baking, as the rod surface picks up the lubricant readily and holds it through the drawing passes. Die life, in drawing rod that has been mechanically descaled in modern equipment, is substantially equivalent to that of drawing pickled stock.

Fourdrinier Wire Quality

When the first paper making

(*Please turn to page* 1381)

Facilities for Wire Irradiation with An Electron Beam Generator

(*Continued from page* 1330)

This monitoring normally consists of film badges which are worn by the people and replaced periodically, then read to determine the radiation received. Such services are in common use and available throughout the country from reputable companies. Particularly valuable in pilot plant aspects where all production variables have not been completely worked out are pencil chambers for the personnel. The advantage of these is that they can be read daily or more frequently if desired, to determine immediately whether or not there has been any radiation exposure. These personnel checks are not made with the anticipation that people will be exposed to undesirable radiation in the process, but are a matter of good business practice. It must be remembered that a personnel radiation monitoring system is only as good as it is enforceable. A film badge or dosimeter pencil left in one's desk will only serve to defeat a system designed for one's protection.

* * *

With properly selected irradiation equipment it is not expected that there will have to be any skill level increase in the operating personnel of the wire plant. It is advisable that certain people be specifically trained in operation of the electron beam generator and assigned to it. We believe that the training necessary to operate the electron beam generator is less than that required to operate the other apparatus found in wire and cable plants. Routine maintenance can be performed by plant personnel. More extensive maintenance will normally be in the hands of the trained service people employed by the manufacturer of the equipment.

* * *

The irradiation process itself is not particularly complicated, the material is passed through the beam of radiation. The amount of radiation absorbed by the wire is determined by the control of the electron beam generator's output voltage and current and the speed at which the wire is passed through the beam area. The individual ingenuity used in designing the wire processing equipment will determine the utilization efficiency of the beam of radiation. An artist's sketch showing the electron beam generator and processing fixture is in the appendix.

* * *

The development of high powered electron beam generators has made the cost of irradiation processing very realistic today. The cost of irradiation is intimately concerned with the particular company, its facility and especially its process. The following is an approximate cost breakdown of a 2 million volt, 10 kilowatt facility. The operating costs were arrived at by assuming 4000 hours of operation a year. The capital costs were amortized over a 5 year period.

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Other maintenance	10,000
Process attendent	60,000
Power	5,000
	$320,000

The hourly cost for complete amortization would be approximately $16.00 per hour.

* * *

The key to the economy of electron processing is the low processing cost per pound that can be obtained. Cost per pound processed depends upon the dose given, the degree of utilization of the radiation beam and equipment and other factors. Generally though we can think of the irradiation process as costing in the order of cents per pound. Each process should be separately estimated to correctly factor in all the variables. Equipment manufacturers will gladly assist in making estimates when so requested.

The Impact of Modernization In Wire Weaving

(*Continued from page* 1341)

quality control becomes more acute as new machines are introduced. Much has been said about the production of quality wire and we do not presume to make further recommendations in this regard. We do know, however, that it is absolutely essential that standards be established and maintained for drawing fine wire to obtain the best performance on high speed weaving equipment. Flat wire, improperly annealed wire, out-of-round irregular surface conditions of the wire, the improper use of lubricants in wire drawing, etc., can all contribute to retarding both the efficiency and the quality of wire cloth being produced. The maintenance of proper standards and mechanical conditions in wire drawing may appear to be an unnecessary cost, but they are negligible when compared to the expense of making scrap, seconds, and two-piece rolls. A good many labor dollars have gone into the raw material before the weaving operation

For Moisture Resistance, Specify

TEXTILENE

TWI-FLEX and TWI-WAX

Treated to reduce wicking and prevent leaching, lightly waxed Textilene Twi-Flex and heavily waxed Textilene Twi-Wax provide effective resistance to moisture. Both fillers are extensively employed for non-metallic sheathed cable (building wire), maritime shipboard cable, varnished cambric cable, and underground service entrance cable.

Twitchell's superior Textilene line also includes: Soft, dry fillers — *Twi-Port* and *Glascor** (Fiberglas-centered for high tensile strength without added bulk). Used for control, power, appliance, coaxial and communications cables, and all portable and flexible cords.

Fungus-resistant filler — *Twi-Tar.* Used for buried communications cable, expanded ACSR cable, and in other applications.

*Patent Applied For

For Every Wire and Cable Application
Twitchell's TEXTILENE Fillers Fill The Bill

Quality-controlled materials that are dependably uniform . . . in standard forms, or customized to special needs.

Initial low cost with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

Assured supply from a reliable domestic source . . . always available in economical and convenient packaging.

Proved performance as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

FREE — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

E.W. TWITCHELL INC.

Third and Somerset Streets, Philadelphia 33, Pa. • REgent 9-7800

PAPER PRODUCTS FOR THE WIRE INDUSTRY

Twisted • Folded • Pressed • Crushed • Shaped • Braided • Woven

WARDWELLIAN®

PAPER SERVER —TYPE "C"

STANDARD EQUIPMENT

Another in the outstanding series of Wardwell serving machines. This machine is designed to serve four ends of flat paper to electrical conductor for the production of Non-Metallic Sheathed Cable.

Paper passes through a die located at serving point, thereby producing a product with a firm, smooth finish and of uniform diameter over its entire length.

"WARDWELLIAN" Paper Server *General Features*

- Machine is equipped with electric stop-motion.
- Production dependent upon requirements. Will produce 1407 feet per hour when machine is applying material at 10.6 turns per foot.
- Standard set of twelve change gears furnished with each machine.
- Serving head speed 250 RPM.
- Driving pulley 8" diameter; 1¾" belt. Speed 575 RPM.
- Ratio pulley speed to serving head speed 2.3 to 1.
- Capstan 18" diameter, 3" face.
- Opening through serving head ⅝" diameter.
- Supply packages 14" diameter, 1½" hole; paper up to 1½" wide, .003" thick.
- Maximum power requirements .6 HP including power transmission equipment.
- Motor drive can be furnished upon request.
- Stands can be furnished to accommodate reel 30 inches in diameter with overall widths up to 16 inches.
- Special windup driving parts required for reels with drums under 8" diameter.
- Reels are not included with machine.
- Weight approximately 508 lbs.
- Weight crated for domestic shipment approximately 615 lbs.

Counter for measuring product in feet or yards furnished upon request.

There are nearly thirty different applications for Wardwell equipment, including Braiding, Shielding with wire, Tape Serving, Yarn Serving, Asbestos Serving, Paper Serving, Armor Serving and Resistance Wire Serving.

REPRESENTATIVES
FOR EUROPE, BRITISH COLONIES
AND DEPENDENCIES
JAMES MACKIE & SONS, LTD.
BELFAST, IRELAND

Wardwell
BRAIDING MACHINE CO.
CENTRAL FALLS, RHODE ISLAND, U.S.A.

133-9

and it seems logical to stop this waste before additional cost is applied to it. It is our opinion that one of the biggest needs in the wire industry is a practical method of checking all of the properties of a finished length of fine wire.

* * *

The problem of quality control does not end in the wire drawing department, however. Taking a lesson from the textile industry we have noted that it is vitally important to maintain a system of records throughout the mill which will permit supervision to trace back and pin point the personnel, machine, area, or combination of the three that has caused low quality work. Inspectors of finished goods do little good if the faults they detect cannot be traced back and corrected immediately. If the mill uses the wire for a warp which has its source from several different machines and final inspection rejects the finished cloth it is virtually impossible to correct the source of trouble without adequate records. Your customer wants and demands quality. With the equipment available today this quality is possible, but not without a studied effort on the part of the mill owner to correct and modernize his methods as well as his equipment. Competition is growing not only from within the industry itself but from substitute materials as well.

* * *

Some physical operations are also affected by the introduction of high speed weaving machines. Since the small filling bobbin utilized by the bar is eliminated, the spool produced on the fine wire drawing machine becomes the key to successful weaving. For example, on a woven wire fabric of 40" width in the reed, filling wire is being pulled off over the flange of the spool at a speed of 30 feet per second. Improperly maintained spools will introduce defects in the cloth and reduce machine efficiency. It seems rather fruitless to spend thousands of dollars for modern equipment only to penalize its operation by faulty supply packages.

* * *

The makeup of the warp drum itself for high speed equipment

should also have considerable attention. The Warner & Swasey warp drum can accommodate about eight times the length of wire as a conventional wire drum. Because of the greater amount of wire on the drum, tensions on the individual warp wires are extremely important. It must be remembered that a tremendous inventory is wrapped up in a warp drum ready to run in a weaving machine and once the drum is made there is nothing the weaver can do but to run it out despite its condition. Emphasis should be placed on the preparation of the warp since it is the key to quality wire cloth.

* * *

Some years ago a few wire weavers developed a creel infeed instead of the warp drum. This is a method whereby each individual wire fed to the loom is from a large spool and has certain definite advantages to the mill fortunate enough to have sufficient floorspace to accommodate it. With the introduction of higher speed weaving equipment, this method of infeed is gaining in popularity. The two obvious disadvantages of this layout are the high inventories of wire required behind each machine and the large area required for the creel or rack itself. On the other hand it makes almost continuous weaving possible. There is no machine stoppage to put in new warps, the weaver can change widths to satisfy special order requirements with a minimum amount of downtime, tensions of the individual warp wires are easier to maintain, and the machine fixer can devote more time to preventative maintenance schedules and quality control since he is not spending the majority of his time putting in new warps.

* * *

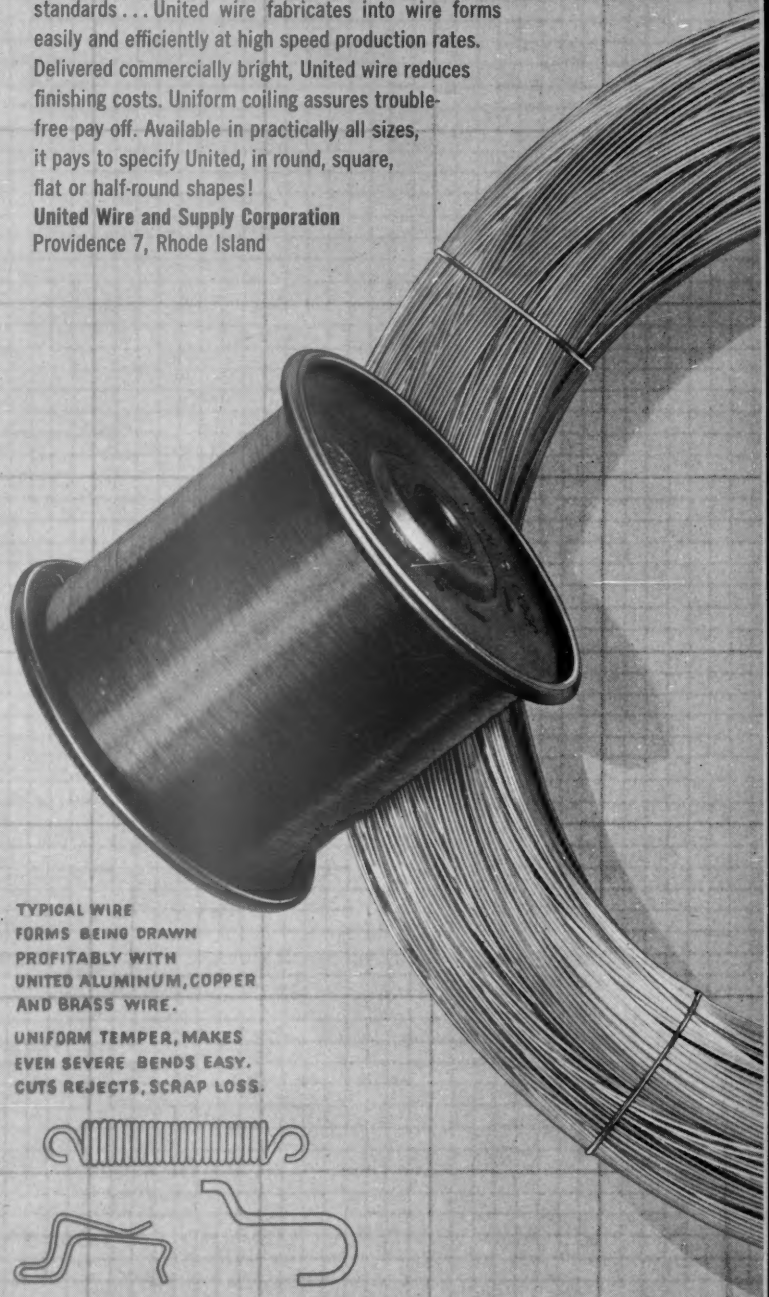
Still another operation is affected by the introduction of more productive equipment. It is common practice now at a warp change to stop the loom and to "stick in" the new warp with the loom standing idle. The warp beam is placed ed on the rear of the machine and then the individual wires are threaded through the heddles on the harness and through the reed. This method usually takes about

TOLERANCE

Reason why — it Pays to Specify
United Aluminum, Brass and Copper Wire

Drawn or shaped to your most exacting tolerance and temper standards . . . United wire fabricates into wire forms easily and efficiently at high speed production rates. Delivered commercially bright, United wire reduces finishing costs. Uniform coiling assures trouble-free pay off. Available in practically all sizes, it pays to specify United, in round, square, flat or half-round shapes!

United Wire and Supply Corporation
Providence 7, Rhode Island



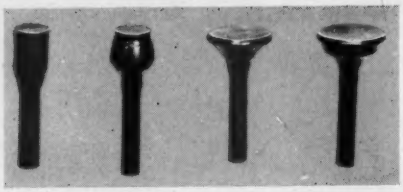
TYPICAL WIRE FORMS BEING DRAWN PROFITABLY WITH UNITED ALUMINUM, COPPER AND BRASS WIRE.

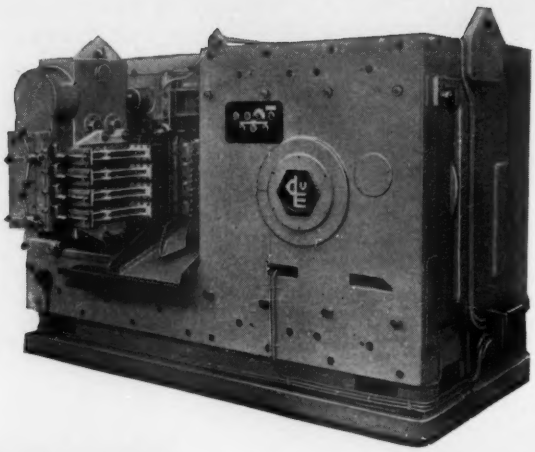
UNIFORM TEMPER, MAKES EVEN SEVERE BENDS EASY. CUTS REJECTS, SCRAP LOSS.

For aluminum, brass and copper wire and tube
For silver brazing alloys . . . always Specify

UNITED

COLD FORMING DIFFICULT PARTS...





WITH THE

BOLTMASTER

Hexagon Socket Screws, Shafts with Geared Shoulders, Hexagon Head Bolts, Shoulder Screws, Engine Valves and bolts having 5 different diameters are normal applications for these German built cold forming machines.

★ ONE WORK CYCLE—permits completion of very intricate parts

★ PRESSING DIES AT 4 WORK STATIONS—conveniently arranged "getatable" position

★ WIRE FEED AT RIGHT ANGLES to the forming slide movement—blanks cut off by main slide eliminating separate cut-off mechanism

★ TRANSFER OF PARTS—by simple transport levers or permanent magnets. Whole mechanism can be swung aside making dies readily accessible

★ POSITIVE EJECTION in punches of 2nd and 3rd station—standard equipment

★ 4 MODELS—capacities 3/8", 1/2", 3/4" and 1" bolts

Write or Phone CL 2-7081 for details!

SOLD AND SERVICED IN U.S. AND CANADA BY

The BOLTMASTER Co.

Exclusive importers of German Craftsman Peltzer & Ehlers Machinery—builders of machinery for the Bolt Industry since 1888

5307 West 130th St., Cleveland 30, Ohio

four hours. Some mills save considerable downtime by sticking-in the warp away from the loom. In this way the warp, harnesses, and reeds can be ready to drop in the loom the minute the previous warp runs out and valuable time is saved in getting the loom in operation again.

* * *

Materials handling equipment can also greatly aid the mill in keeping productive equipment in operation. Overhead monorail systems can be used to bring the warps to the machines. Some mills have devised special electric operated trucks which carry the beam, harnesses, and reeds to the machines — thereby saving much time for the fixer. Hydraulic lifts place the beam into the loom instead of the brute force of two men usually required for this operation. Special filling wire spool trucks are utilized in some mills to assure a constant supply of filling at the loom within easy reach of the weaver.

* * *

While some of the above points may seem of small importance, they all contribute to more profits for the mill owner. These points are particularly important at this time when the demand for high quality grows consistently stricter and the line between profit and loss grows consistently thinner. Substantial savings are now available to the mill owner but new equipment can only achieve optimum efficiency with the complete understanding on the part of the mill owner of the conditions which contribute to that desired efficiency.

Issues Brochure on Wire & Cable Equipment

The Davis Electric Company, 53 Parker St., Wallingford, Conn., has issued a new brochure on the equipment made by them for electric wire and cable plants.

* * *

Included in the brochure are illustrations and descriptions of spark testers, capstans, take-ups, pay-offs, measuring machines, Teflon extruders, coilers, strippers (for salvage), and cooling troughs.

These come in varying sizes and types to meet the many needs of the industry. The machines embody many exclusive design features.

* * *

The demand for Davis equipment has necessitated moving to new and larger quarters at the above address, where three times the original floorspace is available for manufacturing purposes.

* * *

The new brochure will be sent by the manufacturer to interested persons upon request.

1958 Proceedings Published By ASTM

The American Society for Testing Materials announces the publication of its 1958 ASTM **Proceedings,** Volume 58. The 1430-page volume, recording the technical accomplishments of the year, includes reports and papers together with discussion offered to the society during the year and accepted for Proceedings. The volume includes the Summary of Proceedings of the ASTM 61st Annual Meeting, listing by title and author the programs for each session.

* * *

There are 74 reports of technical committees which together with appendices provide a wealth of useful information as do the 51 technical papers and discussions on a wide variety of subjects pertaining to research and testing materials.

* * *

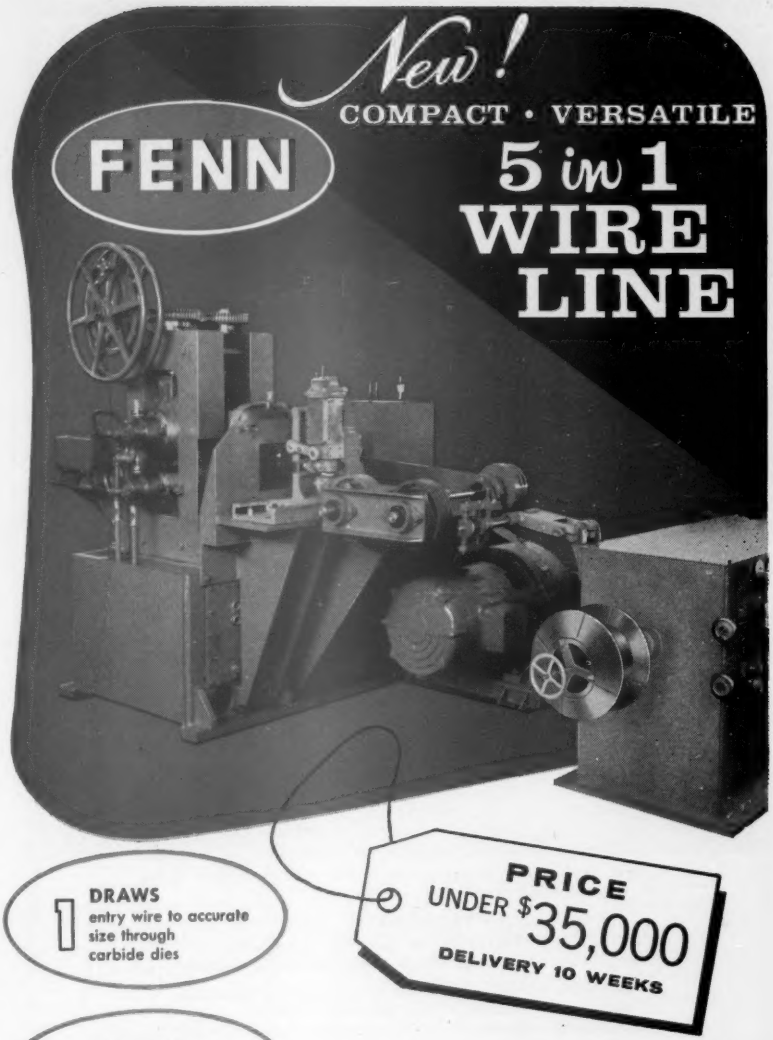
Copies of the **Proceedings** may be obtained from the American Society for Testing Materials at $12.00.

New NEMA Standards Publications

The following NEMA Standards Publications have just been published, and copies are available for immediate distribution:

WC-1959, Color Coding of Wires and Cables

The color coding of the following types of wires, cables and cords is the subject of this publication: asbestos, asbestos-varnished cloth and asbestos-thermoplastic insulated wires and cables; textile coverings for flexible cords; and


New!
COMPACT • VERSATILE
FENN
5 in 1
WIRE
LINE
PRICE
UNDER $35,000
DELIVERY 10 WEEKS
1 DRAWS entry wire to accurate size through carbide dies
2 FLATTENS wire in precision 8" mill with water cooled carbide rolls
3 SIZES AND EDGES SIZES AND SHAPES in versatile Turks Head
4 GAGES thickness with P & W electro-limit gage
5 BUNDLES traverse wound coils, traverse wound spools, loose coils.

Here is the new Fenn 5-in-1 Wire Line with a price as remarkable as its performance and compactness. It will produce precisely flattened or shaped, edged, and sized bundles at speeds up to 600 FPM in an absolute minimum of floor space. Inlet capacity up to ⅜" diameter. The Precision Fenn 8" Roller Bearing Rolling Mill has carbide shell rolls with internal and external cooling. The entire line operates from a single, infinitely variable speed AC motor with simple electric controls. The 5-in-1 Wire Line is engineered and built to Fenn quality standards. Write for complete specifications.

Fenn Manufacturing Company • 603 Fenn Road • Newington, Conn.

VISIT FENN SUITE DURING WIRE CONVENTION

WHY **KEEP** THE **UPKEEP?**

MAINTENANCE COSTS		TIME OUT
January	VERY HIGH	22 hours
February	STILL HIGH	17 hours

Switch to the

HKP® PORTER *Hydraulic* ONE-HOSE **ROD and BAR CUTTER**

IT'S PRACTICALLY . . .

MAINTENANCE FREE!

To slash those sky-high costs on bar and rod cutting operations and maintenance in your mill you need the superbly efficient, rugged, trouble-free one-hose PORTER HYDRAULIC ROD and BAR CUTTER. An all-job team of 3 Cutterheads and 5 Power Unit sizes offers just the right combination to handle any of your cutting work — faster better and at far lower cost. Here's why:

CONTINUOUS TROUBLE-FREE OPERATION

CUTTERHEAD PROTECTION — that eliminates constant "TIME OUT" and HIGH MAINTENANCE COSTS!

- **LONGER BLADES** with more bearing surface and rigid alignment eliminate side thrust and blade breakage.
- **FILTERED AIR** taken into the cylinder is forced out around the movable blade on each cut — eliminates the danger of dirt reaching bearing surface causing oil leakage and wear.
- **CONCENTRIC DESIGN** eliminates excessive wear of cylinder wall and ram.
- **LARGER CYLINDER AREA** allows the tool to cut capacity stock at a lower operating pressure, resulting in longer life for seal and hose.
- **SAFE, 12 VOLT CONTROL SWITCH** at the cutterhead gives instant finger-tip performance.
- **"KEY-POINT"** wear and replacement reduced to the minimum because of these exclusive HKP features.

A TRUE HYDRAULIC SYSTEM with these efficient, maintenance-saving features:

- **CONTROL VALVE** big and accurate enough for all industrial work. Solenoid operated.
- **EASY TO CHANGE RESERVOIR TYPE 10-MICRON OIL FILTER.**
- **PLUS** many other exclusive HKP features.

Ask to have a Porter Engineer tell you how the 3 CUTTERHEAD sizes and 5 HYDRAULIC POWER UNITS can provide the exact combination for your requirements.

OR — WRITE FOR COMPLETE PORTER HYDRAULIC ROD and BAR CUTTER FOLDER.

ATTENTION! Production and Quality Control Depts. Ask about our **NEW UPSET TESTING MACHINE!**

H. K. PORTER, INC. Somerville 43, Mass.

POSJ flexible cords; rubber-insulated wires and cables. (30 cents per copy)

WC3-1959, Rubber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

Both the Insulated Power Cable Engineers Association and NEMA have approved this publication which gives detailed information on conductors; insulation; shielding and coverings; cabling, fillers, binders and circuit identification; testing and test methods; pole and bracket cable; nonmetallic neoprene-jacketed mine power cables; preassembled aerial cable using copper conductors; and neutral-supported secondary and service drop cables. ($4.00 per copy)

Reynolds Boosts Production To Capacity

Reynolds Metals Company is boosting its primary aluminum output to 100 per cent of rated annual capacity — 601,000 tons, **R. S. Reynolds, Jr.**, president, announced in June.

* * *

Continued demand for additional aluminum to meet customers' needs in all market areas has made it necessary to put production on this basis. The order affects two potlines at the company's Listerhill, Ala., reduction plant, and a few "pots" at Jones Mills, Ark.

Wire And Cable in Japan

Modern, efficient plants, together with skilled, low-cost labor, have put Japan's wire and cable industry in a position to supply its domestic needs, and to increase its exports substantially, a role not to be underestimated, especially to countries whose geographical position favors such trade. In order to prevent the export of products that do not conform to quality standards and specifications, the manufacturer for export must submit products for testing to the the Association of Japanese Exporters of Electric Wire and Cable. Only after approval is received can the wire and cable be exported.

* * *

The Japanese wire industry produces bare aluminum and copper wire, wire rod, copper strands and rope, rectangular copper wire, copper welding wire, copper-cadmium alloy wire, silicon bronze wire, overhead conduit wire of cadmium and silicon bronze alloys, hollow core cable, etc. ACSR is manufactured, with all cable fillings, such as distribution termi-

nals, coupling boxes, connectors, and clamps for bare copper or aluminum wire.

* * *

Among insulated products, wire is covered with asbestos, cotton, silk, paper, glass fiber, and enamel or plastics. In this group also is weatherproof wire and cable, to which a multitude of materials, as rubber, polyethylene, PVC, nylon, and synthetic rubber have been applied.

* * *

In the power cable category, special finishing is also offered, such as oil and gas filling, armored cable, and submarine cable of high resistance to corrosion. The industry produces practically all types of cable.

—Translated by Dr. Jerome W. Howe from Draht-Welt.

High Voltage Test Sets

The 1959 catalog data sheets on deluxe Sensitive Hipot Testers, economy line Standard Hipot Testers, DC Overpotential Testers, High Power Test Sets AC, DC, and AC/DC, Corona Test Sets, continuous production type Insulation Testers, Wire "Sparkers", Continuity and Leakage Testers, Cable Fault Locating Sets, etc., are available on request.

* * *

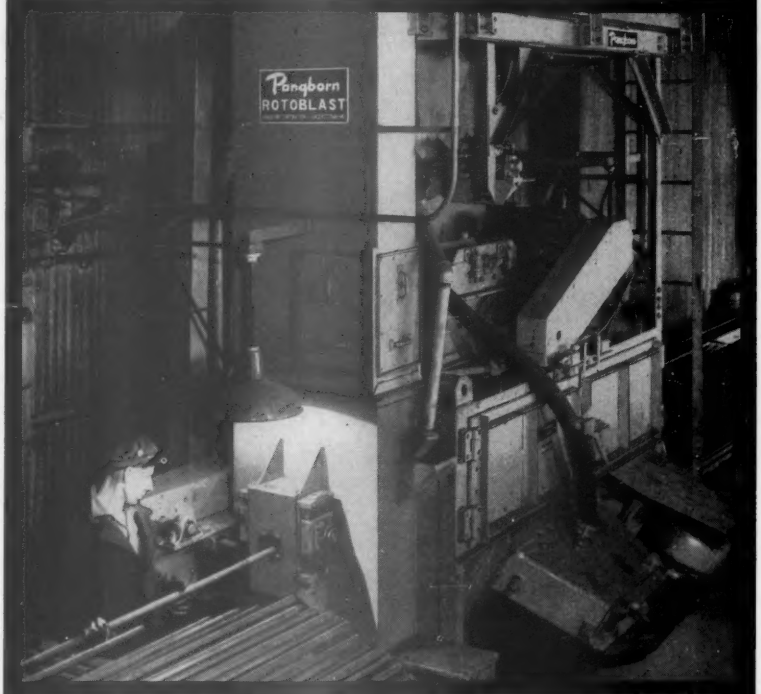
Write to Peschel Electronics, Inc., Dept. A, Patterson, Putnam County, New York.

Barbed Wire For Lightning Rods

The story of barbed wire for fencing is an American one, but what of the much earlier use of barbed wire for lightning rods? Back in 1840, **R. S. Newall**, a wire rope maker and electrical engineer, following the theory of Benjamin Franklin that points on the rods helped to disperse electricity, made a special copper rope bristling with intertwined pointed tufts of wire. This was made at Gatehead-on-Tyne in England and was used on a number of church spires. The innovation was known in 1843 as "Newall's Barbed Lightning Rope" and cost 4s.9d per foot.

* * *

ROTOBLAST CUTS DESCALING COSTS TO 80¢ A TON!



Steel producer descales 6 tons of rod an hour at minimum cost with Pangborn Rotoblast

To facilitate the cleaning of hot rolled rod, a large steel producer has recently replaced former cleaning methods with a Pangborn Rotoblast Descaling Machine.

The quality of cleaning has been excellent and even though the machine is still not in full operation, preliminary runs already indicate increased production capability with greatly reduced costs. In a recent run, 42,000 lbs. of rod were processed in 3½ hrs. blast time—6 tons per hour—and estimated Rotoblasting costs in the range from 1″ to 2″ average about 80¢ per ton. This is *overall* cost . . . including maintenance, power, abrasive and labor.

Of course, the amount of savings vary at different Rotoblast installations. But if *you* must cut costs—whether you have a standard or special descaling problem—your solution is Pangborn Rotoblast. Ask the Pangborn man in your area or write PANGBORN CORPORATION, 5400 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning and Dust Control Equipment —Rotoblast Steel Shot and Grit.*®

Pangborn

Cleans it fast with ROTOBLAST®

CONTINENTAL®

Brytite®

A PATENTED GALVANIZING PROCESS

CHAIN QUALITY WIRE

The Zinc Coated Wire with the Plated Look

Brytite Wire is so shiny bright and satin smooth that electroplating and special finishing operations are not needed —a valuable saving in labor and materials! The coating is so tight that it withstands severe deformation of the base metal—takes hard turns and twists without flaking, powdering, or peeling.

In Many Sizes, Finishes, Tempers and Analyses

Specify BRYTITE in Satin Finish, Unwiped, or redrawn (in certain sizes) . . . in various tempers and analyses in low carbon and medium low carbon steels . . . for quality weldless or twisted wire chain, or wherever long-lasting brightness is desired. Special shapes, too.

Free Manual of Continental Manufacturers' Wire. Contains details of BRYTITE and other types of Continental Wire. Write for copy.

Fine Finishes in Manufacturers' Wire

CONTINENTAL STEEL

CORPORATION—KOKOMO, INDIANA

PRODUCERS OF: Manufacturers' Wire in many sizes, tempers and finishes, including Galvanized, KOKOTE, Flame Sealed, Coppered, Tinned, BRYTITE, Annealed, Liquor-Finished, Bright, and Special Shaped Wire. Also Reinforcing and Galvanized Fabric, Nails, Continental Chain Link Fence, and other products.

In those days glass insulators were used to insulate the rod rope from the spire, a bad principle in modern lightning engineering practice, since the holes in the glass cups had to be made large enough to admit the barbs as the rope was threaded through. There is no doubt, in the light of the latest scientific research, that the use of a multiplicity of points on the wire cable was sound. The barbed rope was condemned by the steeplejacks of the period who were not partial to handling it on their lofty perches and it fell into disuse before 1850. So, barbed wire was used on the church steeple before it appeared on the cattle range.

—Contributed by C. J. Robb

Magnathermic Acquires Two Ajax Firms

Ajax Engineering Corp., makers of low frequency induction melting furnaces, and **Ajax Electrothermic Corp.**, high frequency induction melting equipment manufacturers, both of Trenton, N. J., have been taken over by the Magnathermic Corp., of Youngstown, Ohio. The two corporations will hereafter operate under the name **Ajax Magnathermic Corporation.**

Induction Heated Extruders Announced

General Engineering Co. (Radcliffe) Ltd., Bury Road, Radcliffe, Lancs., England, has announced a new line of thermoplastic extruding machines embodying controlled induction heating and air cooling for insulating electric wire and cable.

* * *

These machines are said to reach working temperatures more quickly than other methods. For example, on a 2½ inch machine the barrel temperature is brought to 150°C in 13 minutes and to 195°C in 24 minutes. Maximum temperature is about 350°C. Under exothermic conditions on PVC compounds faster screw speeds and greater output have been found to be possible.

* * *

Please write to the manufacturer for detailed information.

Outstanding Personalities of the Wire Industry

Elected Treasurer of Rockbestos

Elmer E. Barth has been elected treasurer of the **Rockbestos Wire & Cable Co.** Division of **Cerro de Pasco Corp.**, it was announced recently by **Albert S. Redway**, president of Rockbestos. He succeeds **Leonard W. Smith**, who has retired.

* * *

Mr. Barth has been associated with Rockbestos since 1956, when he joined the company in the capacity of chief accountant. He was named assistant treasurer in 1957. In addition to his duties as treasurer, he fills the post of assistant secretary for Rockbestos.

Carpenter Names Managers In Detroit

The Carpenter Steel Company, Reading, Pa., has appointed two men to managerial posts in the Detroit area.

* * *

O. T. Thompson, formerly branch manager of Detroit, now becomes district manager, following the retirement of **C. O. Ericke.** He joined Carpenter in 1948 as a sales representative, working in that capacity until 1954 when he became assistant branch manager, and in 1956, branch manager. He attended the University of Minnesota.

* * *

H. H. Moeller has been promoted to branch manager of Detroit, succeeding Mr. Thompson. He has been a sales representative in the Detroit territory since 1950, when he joined Carpenter Steel. He is a graduate of the University of Michigan, holding a B.A. degree.

American Pulley Appointments

The American Pulley Co., Philadelphia, has announced promotions for six men in a reorganization program of the production and engineering departments to improve the customer service operations.

* * *

Charles E. Bain has been named general works manager in charge of engineering and manufacturing. Previously he had been manager of manufacturing. He joined American Pulley in 1952, is an industrial engineer and holds two university degrees.

* * *

W. L. Leonard, now chief engineer, power transmission equipment, holds a Bachelor of Science degree from North Carolina State awarded in 1942 and a masters degree from the same school.

* * *

W. S. Nichols, now chief engineer, material handling and pressed metals specialties, was previously assistant to the manager of research and development. He was educated in Sweden and attended Worcester Institute of Technology in this country. He joined American Pulley in 1957.

MEMO

TO CABLE MANUFACTURERS

Need cable filler specialties? Keep these Plymkraft specialties in mind:

- Insulation Braider Cord
- Fungus Resistant Cable Fillers
- Water Resistant Tissue Cable Fillers
- Stranded Polyethylene Cable Fillers
- Poly-Vinyl Chloride Cable Fillers

We will be glad to consult with you on any special cable filler problem. Call or write any office below.

296 State St. Boston, Mass. CApital 7-1134

323 West Polk St. Chicago, Ill. HArrison 7-6238

750 Bay St. Toronto, Ont., Canada EMpire 3-4281

366 Madison Ave. New York, N. Y. YUkon 6-9230

P.O. Box 10215 New Orleans, La. VErnon 5-7243

70 Sacramento St. San Francisco, Calif. GArfield 1-4709

PLYMKRAFT DIVISION

Plymouth Cordage Company, Plymouth, Massachusetts

Manufacturers of Waxed Cable Fillers, SJ Cable Fillers and Range Cable Fillers

PLYMOUTH TRADE MARK 1824

One of these **PARKIN PRODUCTS** might well be your Answer —

WHITE RUSTING OF ZINC COATED PRODUCTS: —

New protective chromate coating for zinc surfaces. Operates at room temperatures. Protection applied in a matter of seconds. Guards your product during storage and transit. Retards formation of White Bloom or White Products of Corrosion. PPC #65 in powdered form, using 8 ounces to the gallon.

ACID ZINC BRIGHTENING AGENTS: —

A new brightener for electro-galvanizing. Better grain refinement. Increase of throwing power. Permits a brighter deposit on metal surfaces. PPC #73 will impart a luster finish to your products.

NEW NEP #K3 "ALL CLEAR" INHIBITOR: —

A new, water clear (NO TAR BASE) inhibitor for your pickling processes. Eliminates threat of staining or tar spots on metal. Reduces acid and metal loss during acid cleaning operations.

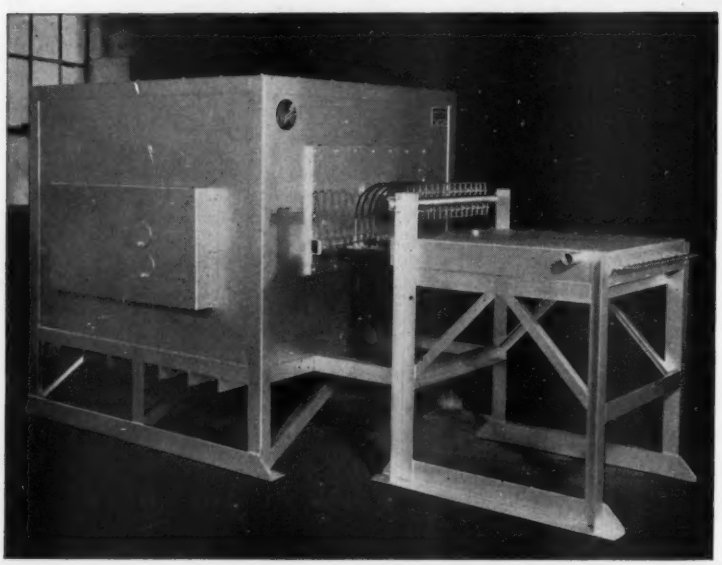
These products are just a sampling of the many PARKIN CHEMICAL COMPANY'S compounds available to the Steel Industry. Others include a complete line of pickling chemicals, steam jet agitators for pickling, lanolin based protective oils, pullers and jaws for wire drawing operations, and acid additives for low cost cleaning of Steel.

PARKIN CHEMICAL COMPANY

Highland Building
Pittsburgh 6, Penna.

HARPER STRAND ANNEALER

delivers bright stainless wire continuously at high speeds



Operating at temperatures from 2000°F. to 2200°F., this 30 tube Harper Electric Strand Annealing Furnace turns out Type 304SS wire bright and clean. Sizes from .02″ to .0014″ are passed through its 40″ hot zone at rates up to 100 FPM per tube.

Providing close temperature control, Harper Strand Annealers maintain extremely dry reducing atmospheres to produce a truly bright finish. Designed for dependable, trouble-free performance over long periods, they permit wire speeds up to 150 FPM per tube.

Harper manufactures a full line of automatic conveyor, continuous tube, and bell type annealing furnaces for billets, bars, rods and wire. To solve your wire problem most profitably, call in a Harper engineer or write: Harper Electric Furnace Corporation, 42 River St., Buffalo 2, N.Y

HARPER
ELECTRIC FURNACES

H. W. Leadbeater, who had been plant engineer, has been made shop superintendent responsible for all shop operations. He came to American Pulley in 1951.

* * *

T. M. Keating has responsibility for control of production and inventory with the title of production manager. He had been chief time study engineer.

* * *

J. T. Richards has become chief industrial engineer having served as assistant to the manager of engineering. He is in charge of tool design, methods and time study.

Roebling Appointments

Robert M. Lamborn has been appointed manufacturing manager of the cold rolled steel products division of **John A. Roebling's Sons Corporation,** a subsidiary of The Colorado Fuel and Iron Corporation, and **R. Garrett Boetsma** has been named manager of Roebling's industrial engineering and planning.

* * *

Mr. Lamborn was formerly senior planning engineer at the Roebling plant at Trenton, New Jersey. A graduate of Northwestern University, he has been with Roebling since 1946.

* * *

Mr. Boetsma was formerly chief industrial engineer at Roebling. He joined the Roebling organization in 1940. He is a graduate of Princeton University.

Nichols Wire Announces New District Managers

The appointment of **Robert E. Huson** as Sales Manager of the Eastern District and **Lloyd G. Miller** as Sales Manager of the Midwest District, has been announced by **Frank R. Nichols,** President of the **Nichols Wire & Aluminum Co.,** Davenport, Iowa.

* * *

Mr. Huson has been associated with the company for nine years as Sales Representative in Philadelphia, and Mr. Miller has been associated with it for five years as Sales Representative in Minneapolis and Chicago.

Firth Sterling Promotes Montgomery

Firth Sterling Inc. announces the promotion of **W. E. Montgomery** to chief engineer, carbide division. In his new capacity, Mr. Montgomery will be responsible for all phases of engineering, sales, process, design, application, and development.

* * *

He joined Firth Sterling 25 years ago, and his experience has encompassed various phases of the carbide industry, including manufacturing, production and sales. Starting in the shop, his work has covered manufacturing and production from the powder stages to finished product. He was superintendent of the carbide engineering department for a number of years before entering the

NESOR ALLOY PRODUCTS CO.

MANUFACTURERS OF WIRE • STRIP • BRAID • STRAND

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FINE WIRE

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IN THE FOLLOWING METALS AND ALLOYS

ALUMINUM- AND ALLOYS	MONEL-NICKEL	COPPERCOATED STEEL
BARE AND TINNED COPPER	STAINLESS STEEL	SILVER PLATED COPPER
LEAD AND SOLDER ALLOYS	STEEL-LOW AND HIGH CARBON	BRASS AND ALLOYS
PRECIOUS METALS	RESISTANCE WIRE	PHOSPHOR BRONZE

Exacting size tolerances — uniformity of tempers, a good product and prompt service. A dependable supplier soliciting your business.

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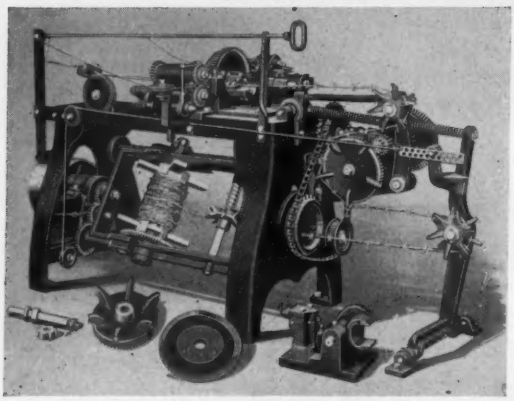
"West Coast Representatives, Harry Appleton Co., Inc., 136 San Fernando Road, Los Angeles 31, Calif. Phone, CApitol 5-5611, Sales Engineers for Your Convenience."

GLADER BARBED WIRE MACHINES



USED THROUGHOUT THE WORLD . . . for producing barb wire of any style or type of 2-point or 4-point wire, made from round wire.

GLADER COMBINATION BARB WIRE MACHINE . . . make 2-point and 4-point barb wire.

GLADER BARB WIRE MACHINES also makes 2-strand plain cable wire, without barbs.

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Also manufacturers of the world-renowned GLADER WIRE NAIL MACHINES, producing wire nails from 1/4" brads to 12" spikes.

Write for Bulletin No. 32

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. . . indicate a world-wide reputation. Hanson & Edwards have supplied High Speed Tubular Stranding Machines to many of the most important Wire Rope and Cable factories throughout the world. These machines have rotors which run in large SPLIT ROLLER BEARINGS, not on support rollers, giving higher speeds, smoother running and lower maintenance costs

ROLLER BEARING TYPE HIGH SPEED TUBULAR STRANDING MACHINES

Made in various sizes for reels from 5"x 2½" up to 24"x 12" Write now for details

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P2035

sales department as chief sales service engineer.

Baudouine Advanced by Elgin

The appointment of **William H. Baudouine** as general manager of the **Abrasives Division, Elgin National Watch Company,** was announced this week by **George J. Daly, Jr.,** Executive Vice President.

* * *

He joined Elgin in 1953 as a sales engineer in the northern Illinois area. In January of 1956 he was appointed sales manager for the division, which position he has held until this appointment. He graduated from Northwestern University with a degree in mechanical engineering.

New Edging for Wire Cloth Braid Weave Gives Firm, Safe Edges To Wire Cloth

Wire cloth woven with an integral flat braid has been introduced by **Reynolds Wire Division, National-Standard Company.** The baid weave provides a firm, workable edge. The strengthened edge can be gripped, embedded or otherwise fastened by methods previously impractical with wire cloth. Safety from injury due to sharp cross wires is improved.

* * *

Braid weave is available in 2-mesh to 8-mesh hot-dip galvanized wire cloth. It is woven up to 48 inches wide, and may be slit from 2 to 12 inches wide.

* * *

Braid weave is made by including a flat braid as a warp (lengthwise) wire. The wire cloth is hot-dip galvanized after weaving, and is then slit through the braid to the reinofrced edge (top photo). Cross wires are held firmly in place and the edge of the slit cloth is structurally strengthened by the braid.

Catalog of Marking Machines

A new Markem catalog describes practical methods and equipment for clear, fast marking of all types of electrical and electronic products. A product index, ranging from wire lead components to panels and chasses, guides the manufacturer to the best marking method for his product; marking curved, flat or irregular surfaces; production runs with infrequent changes of marking, or short runs with frequent imprint changes. Special sections also describe machines for Underwriters' Laboratories manifest label legend marking; color banding; screen process printing; tape and label printing; wire and tube marking; and special marking machines utilizing Markem "Unitized" printing heads.

* * *

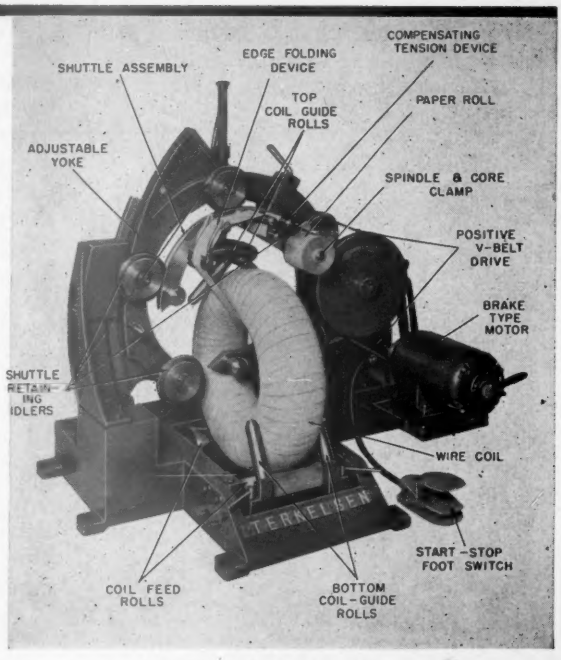
The catalog can be a valuable reference for electrical/electronic manufacturers, to help them obtain sound recommendations from Markem on the best combination of machine, ink and printing element for their marking requirements. Copies are available on request from **Markem Machine Co.,** Keene 45, New Hampshire.

The NEWEST!

TERKELSEN'S *Model 4-57*

WRAPPING MACHINE

Wraps wire coils 17" to 30" outside diameter, minimum inside diameter of 10", and with a cross-sectional diameter of up to 10". Larger coil capacities available on order.



FEATURES:

- **POSITIVE V-BELT DRIVE.**
- **HIGH-SPEED PRODUCTION** *unequalled by any machine.*
- **TIGHT & UNIFORM WRAP** *of every coil.*
- **BALL-BEARINGS THROUGHOUT.**

For additional information on the Model 4-57 or any of our other 20 standard spiral wrapping machines (for either coils or straight lengths), write to:

TERKELSEN *Machine Company*

Terkelsen Building — 326 A Street, Boston 10, Massachusetts

World's Largest Manufacturer of Spiral Wrapping Machines

Member WAS

Straightline Non-Slip Wire Drawing With Electrical Equipment Using Alternating Current

(*Continued from page* 1361)

similar set-up, this one however, consisting of 4 blocks with motor ratings of 30, 36, 45 and 55 HP, and three speeds of 320, 500 and 800 feet per minute. The basic reduction of the machine is set for 25% and the motor speed at 1800 rpm. If it is desired to draw .375" wire with 30% reduction in area in 4 drafts down to .184" set-ups results in table:

* * *

Since a downward regulation of the motor speed up to 30% is available, it is clear from these figures that a maximum of only 18.8% out of the 30% had to be used to achieve the desired results, so that additional flexibility in speed adjustments is available, should the need for it arise.

* * *

It is also evident that a machine of this type will be able to handle any wire drawing problem arising in the course of ordinary production. It is also interesting to note that the downward regulation of the slip-ring motors is arranged in 15 individual steps in such a way that at step 15 all of the rheostats are cut out with the motors running at 1800 rpm; at step 1 the motors will run at 70% of 1800 rpm, or at 1260 rpm.

Starting size: .375"	1st block .314"	2nd block .266"	3rd block .220" 2	4th block .184"
Reduction in area	30%	30%	30%	30%
Speed built into machine for 25% reduction	135	180	240	320 ft/min
Speed needed for 30% reduction	110	157	224	320 ft/min
Reduction of motor speeds from 1800 rpm	18.8%	13%	6.5%	0%

* * *

Or, if it is desired to draw .375" wire with 20% reduction in area down to .221":

Starting size: .375"	1st block .335"	2nd block .299"	3rd block .267"	4th block .221"
Reduction in area	20%	20%	20%	20%
Speed built into machine for 25% reduction	135	180	240	320 ft/min
Speed needed for 20% reduction	135	169	211	264 ft/min
Reduction in motor speeds from 1800 rpm	0%	6%	12%	17.5%

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- SHAPE DIES
- COLD HEADING DIES
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DEPENDABILITY, EXPERIENCE . . . Your guarantee of products that will do the job for which you buy them.

UNION WIRE DIE CORP.
MAIN PLANT — 375 FAIRFIELD AVE., STAMFORD, CONN.
GENERAL OFFICES — 71 WEST 45th ST., NEW YORK 36, N. Y.

The regulation of each step is so sensitive that a very slight turning of the handwheel will cause the wire to tighten up, or to slacken off perceptively while running to the next block.

* * *

Once the machine is set and the wire running properly from block to block without slip, the regulation of the motors is locked with a safety key and further adjustments will not be necessary. This regulation remains in force as long as the drawing process remains unchanged. The machine may be stopped and started at will without affecting these controls.

* * *

The machine is ruggedly built and the alternating current slip-ring motors are easily maintained. All of the wiring and control equipment is fully installed on the machine, very compact and conveniently accessible, so that only the connections to the main power line have to be provided.

* * *

Editor's Note: Following his paper, Mr. Geiss showed a film depicting the details of construction of the machine and its operation.

Wire Kinks

(*Continued from page* 1365)

machine was invented in the early part of the 19th Century, an endless belt of brass wire cloth was used. Machines were small, speeds were low — 200 to 500 feet per minute — and corrosion and abrasion were not serious factors.

* * *

With some modern machines the filter belt of wire cloth travels at speeds in excess of 2000 feet per minute. Friction and abrasion are greatly increased, demanding precision cloth of high tensiles and resistances to corrosion and fatigue to keep the machines running.

* * *

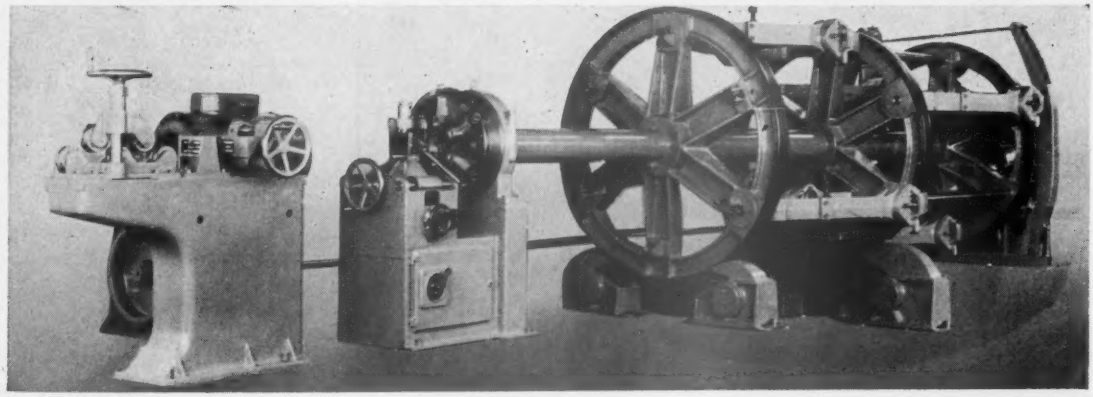
Phosphor bronze wire has found universal acceptance for this application, but it must be smooth, of exact diameters, and precision woven to meet requirements. If the wire in Fourdrinier wire cloth is not evenly spaced, the water, carrying some stock, may go through the meshes and, if too close, the water does not drain off sufficiently, allowing the pulp sheet to enter the rolls in too wet a condition.

* * *

Wire sizes range from around .020′ to .004″ with allowable tolerances of only plus or minus .0001″. Hard drawn wire must be annealed in tube furnaces in a reducing atmophere to prepare the wire for weaving.

Get the habit of reading regularly
WIRE AND WIRE PRODUCTS
The Wire Man's Magazine

WE OFFER SUPERIOR MACHINES MEETING ALL REQUIREMENTS FOR THE MANUFACTURE OF ELECTRICAL WIRE & CABLE, WIRE ROPE ETC.



SHOWN HERE:
6 SPOOL LAYING-UP MACHINE with variable geared back turn for wire ropes from 15 mm (19/32″) to 40 mm (1-9/16″) diam.
Spools: 90 mm (35 1/2″) flange diam. Weight of full spool: 1000 kg (2200 lbs.)

J. A. KRAFT MASCHINENFABRIK, OLPE/WESTF., GERMANY
HANCOR, INC., 468 Fourth Ave., New York 16, N. Y.
SOLE REPRESENTATIVE IN THE U.S.A. AND CANADA

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,837,747, WIRE TWISTER FOR BALERS, patented August 4, 1959 by Patrick L. May, Memphis, Tenn., assignor to International Harvester Company, a corporation of New Jersey.

Ten claims to this patent for a needle-containing wire carrier and twister in which the bale is compressed against the wire, three portions of which are twisted into an inline twist.

* * *

No. 2,898,949, MACHINE AND PROCESS FOR THE PRODUCTION OF CONVOLUTIONS IN WIRE, patented August 11, 1959 by Kalman Z. Huszar, Foster, Ohio.

Serpentine-like bends are produced in wire by a cooperating pair of parallel rotary bending elements comprising solid worms; each comprising an initial cam portion having a relatively large pitch and a tooth height increasing from a minimum to a maximum, a mandrel portion of a smaller and constant pitch and a constant tooth height equal to the maximum; a feeder introducing the wire between the worms above the center lines thereof; and apparatus for rotating the worms at such a speed that the lead of the portion of constant pitch is less than the speed of the wire.

* * *

No. 2,898,950, SPRING ASSEMBLY MACHINES, patented August 11, 1959 by Edward L. Bronstein, St. Paul, Minn., assignor to The United States Bedding Co., St. Paul, Minn., a corporation of Minnesota.

It is stated that the machines will reduce materially the number of operations formerly required to fabricate upholstery spring. The machines are an improvement over the machine described in U. S. Patent 2,351,689. There are 19 claims.

* * *

No. 2,898,951, DEVICE FOR ASSEMBLING VARIABLE SIZES OF FRAMED SCREENS, patented August 11, 1959 by John G. Watt, Miami, Fla., assignor to American Screen Products Company, Miami, Fla., a corporation of Florida.

An adjustable device is disclosed for assembling a frame having grooves on a face thereof, a sheet of screening, and splines adapted to be disposed in the grooves of the frame together with border edges of the screening.

* * *

No. 2,898,952, WIRE UNWRAPPING AND REWRAPPING TOOL, patented August 11, 1959 by Albert J. Lovecky, Flushing, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

The tool is adapted for expanding and contracting an inelastic coil of wire spirally wrapped about on electric terminal.

* * *

No. 2,899,921, APPARATUS FOR MAKING SHEATHED CABLES, patented August 18, 1959 by Reidar J. Nicolaisen, New York, N. Y. and Harold M. McCall, Fairlawn, N. J., assignors to Raymond International Inc., New York, N. Y. a corporation of New Jersey.

Apparatus is patented for forming a cable assembly containing a number of wires separated by spacer elements, these wires being loosely surrounded by a sheath formed of helically wound metal ribbon, the edges of the convolutions of which are interlocked.

* * *

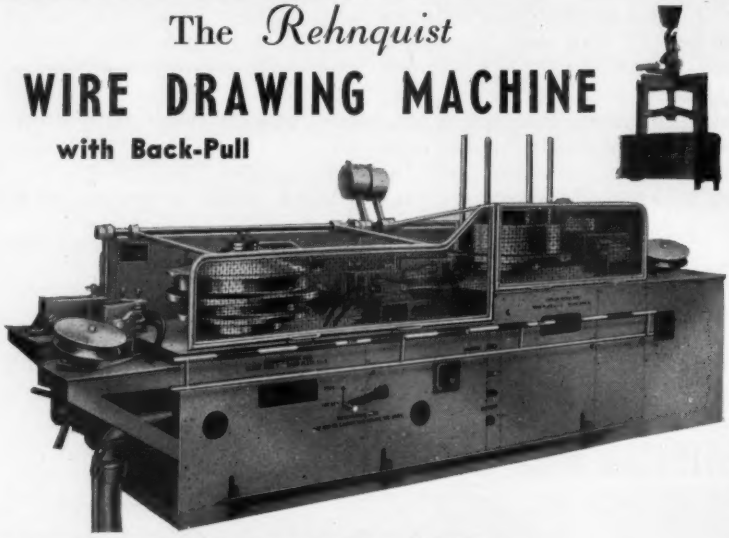
No. 2,900,073, WIRE COILING MACHINE, patented August 18, 1959 by Charles Benjamin Blake, North Haven, and Robert S. Cady, Watertown, Conn., assignors to Scovill Manufacturing Company, Waterbury, Conn., a corporation of Connecticut.

The machine comprises a wire-drawing die with a device for rotating the die to impart a rotating movement to the wire about its own longitudinal axis during the drawing operation, a capstan for pulling the wire through the die, the axis of the die and wire being tangent to the surface of the capstan, a device for bodily revolving the capstan about the axis of the wire and in the same direction as the rotating wire, a device for applying power to the cap-

The *Rehnquist*

WIRE DRAWING MACHINE

with Back-Pull



A NEW CONCEPT OF EFFICIENCY

Counterdrawing, or back-pull, increases die life and consumes less power.

While good for any wire, these machines are especially efficient in drawing Stainless, High Carbon and Resistance Wires.

A single motor drives the machine, different blocks being connected by gears operating through differential gears. Important feature of the differential is the automatic adjustment of all blocks to each other to maintain tensions without slippage. Wire runs from block to block with no accumulation or twisting.

All dies and blocks water cooled. Pneumatic controls stop the machine if reel trouble develops. Full safety features to highest standards built in. Construction is heavy for long service. Finishing block supplied in diameters required for your operations. Machine occupies floor space of 12′ by 9′ overall. Motor is 85 hp, 2-speed AC, 865/1730 rpm. 4-speed gear box gives 8 different speeds of from 108 to 1380 fpm.

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stan to rotate the same on its own axis while revolving about the axis of the wire, and a distributor for receiving the wire from the capstan and directing it outwardly to a coil of the desired diameter, and a device for rotating said distributor around the axis of the wire.

* * *

No. 2,900,437, PORTABLE ELECTRIC CORD, patented August 18, 1959 by Paul F. Thompson, Bristol, R. I., assignor, by mesne assignments, to Kaiser Aluminum & Chemical Corporation, Oakland, Calif., a corporation of Delaware.

An electric cord is disclosed, and said to have high resistance to flex fatigue with the insulated conductor wires wrapped around a core, and a thin elastomeric cover composed of a number of thin layers (including an insulating layer), the insulated conductors being twisted together in the same direction of lay as the metallic strands and combined with filler material to form an assembly. On the exterior are fibrous strands and an elastomeric cover.

* * *

No. 2,900,684, WIRE HANGERS FOR CONCRETE MEMBERS, patented August 25, 1959 by Thomas O. Miles, Jr., Glen Ellyn, Ill.

A folding wire hanger is provided, with companion upright wire units having feet portions with the feet portions of the units hinged to spacer plates.

* * *

No. 2,900,689, ROPE FASTENER patented August 25, 1959 by Harry A. Pearson, Wilmette, Ill.

This invention comprises an upright heavy wire spiral for a knotted rope.

* * *

No. 2,900,710, METHOD OF MAKING COLORED WIRE, patented August 25, 1959 by Leonard T. Hurat, Cleveland, and Edward P. Presby, Garfield Heights, Ohio, assignors to United States Steel Corporation, a corporation of New Jersey.

The method of making colored wire is disclosed, comprising providing a rod, cleaning the rod, applying a wire drawing base coating to the surface of the rod, applying a solution of a water-soluble dye to the rod with the base coating thereon, drying the rod with the dye thereon, and then drawing the rod to wire of the desired diameter.

* * *

No. 2,900,784, CORD AND ARTICLE CONTAINING THE SAME, patented August 25, 1959 by James M. Fenner, Chagrin Falls, Ohio, assignor to United States Steel Corporation, a corporation of New Jersey.

This cord comprises a center core formed of three wires twisted together, and five 6-wire strands laid helically around the core, each strand consisting of six wires twisted together with each wire being on the outside of the strand over part of its length.

* * *

No. 2,900,785, SIX-WIRE STRAND, patented August 25, 1959 by James M. Fenner, Chagrin Falls, Ohio, assignor to United States Steel Corporation, a corporation of New Jersey.

In this cord, there is a metallic strand embedded in rubber with the rubber extending into the interstices of the strand which consists of six individual wires twisted together with each wire being on the outside of the strand over part of its length.

* * *

No. 2, 901,141, WIREBOUND SNAP-ON CRATE, patented August 25, 1959 by James F. Dedmon, Milan, Tenn.

The arrangement of panels and wires is such that the crate body may be folded completely flat. Ten claims.

Alcoa Conduit to be Sold by Rome Cable

Aluminum Company of America has announced that responsibility for sales of all Alcoa aluminum conduit has been transferred to **Rome Cable Corporation,** which recently became an Alcoa subsidiary.

* * *

Addition of the Alcoa line to that of the Rome, N.Y., firm will make available to the electrical industry a full line of aluminum and copper conductors and accessories and aluminum and steel conduit from a single nationally known supplier.

* * *

Dixon Lewis, Alcoa's assistant manager of electrical conductor

THE NEW LOOK

IN DIAMOND DIES

Has swept the country!
It answers the need for lower production costs.

GET THE UTMOST LIFE AND SERVICE
FROM YOUR DIAMOND DRAWING DIES.

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THE "NATDI"

The "NATDI" is a reversible Diamond Die.

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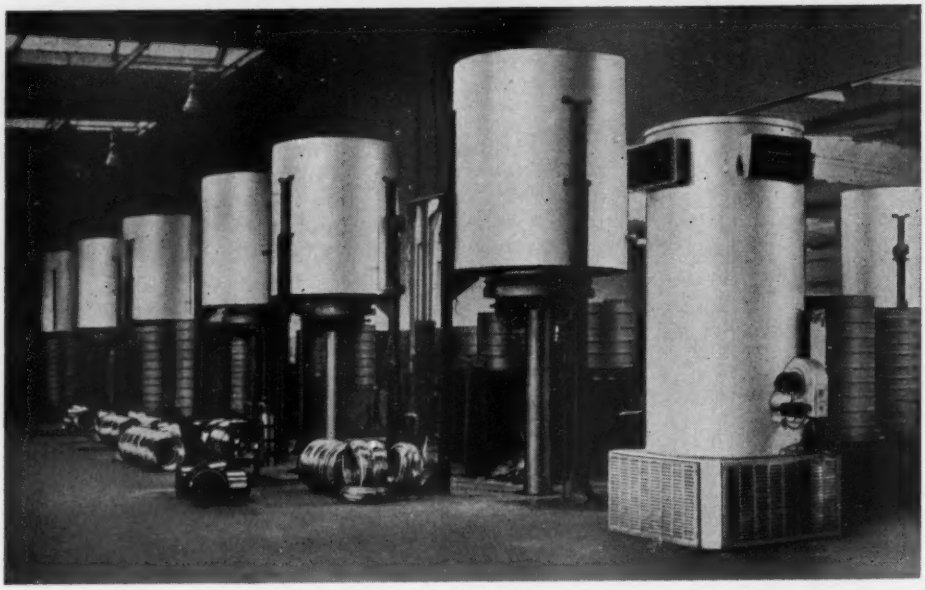

SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST PROMINENT CABLE WORKS IN GERMANY

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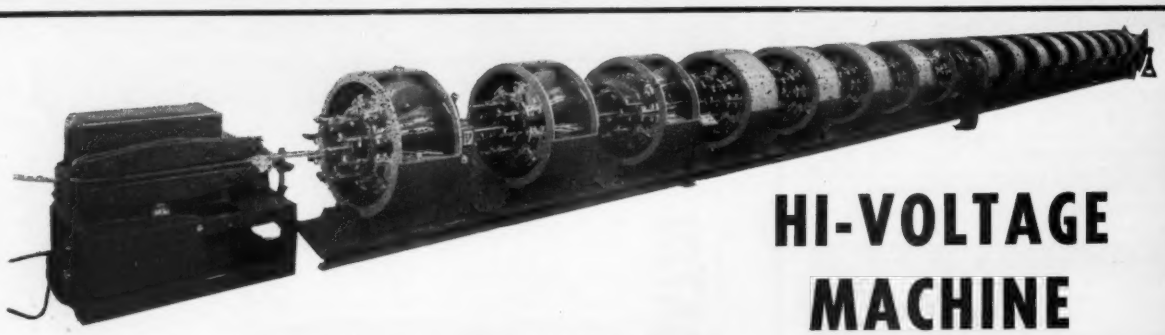


HI-VOLTAGE MACHINE

300 K.V.

- 296 Papers.
- 6 20 Paper Heads, 16" Pad.
- 11 16 Paper Heads, 20" Pad.
- Q.B. Type Caterpillar Haul-off, Maillefer Patent.
- Lay Adjusted by P.I.V. Driving Each Head and P.I.V. on Caterpillar.
- Total Length of Equipment for 296 Papers, Including Caterpillar, but Exclusive of Let-off and Take-up: 118'.

POURTIER Machines

76 a 82, Rue de la Fraternite

ROMAINVILLE (Seine) **FRANCE**

sales since 1953, has been named product manager of conduit for Rome Cable, according to **Glenn Rolston**, vice president and manager of marketing for Rome. Although on Mr. Rolston's staff, he will continue to be based at Alcoa's home offices in Pittsburgh.

Pacific Electricord Cancels Sales to New York Firm

Arnold Schott, President of **Pacific Electricord Company** and **Coast Cable, Inc.**, states that the recently announced sale of these Companies to **Essex Universal Corporation**, a New York Holding Company, has been cancelled at his request, and that, as a result, he has re-acquired all interest in these Companies which are engaged in the manufacture and sale of Electric Cord Sets, Wire and Cable, Electrical Wiring Devices, etc., and will continue its operations as heretofore under Arnold Schott as President.

Bantam Speed Changer Kit

A Metron Bulletin describes a new Bantam Speed Changer Kit which permits the rapid assembly of twenty-nine speed ratios from parts that may be used repeatedly in different combinations. Ideal for designers, laboratory technicians and instructors who need many ratios available at an extremely low cost. Ratios provided are from 1:1 to 44:1. Torques up to 130 oz-in at the low speed shaft and speeds up to 10,000 RPM are easily handled.

* * *

For a copy of the bulletin, write **Metron Instrument Co.**, 432 Lincoln St., Denver 3, Colo.

New Rope Parting Machine

Developed in collaboration with a wire rope manufacturer, **Metropolitan-Vickers Electrical Co., Ltd.**, Trafford Park, Manchester, England, has brought out a new machine for parting wire rope.

* * *

The special feature of this machine is that the rope ends are slightly tapered and sealed, and thus are completely free from loose strands.

* * *

This is accomplished by placing the rope in the machine between two clamping heads and passing an electric current through the point of severance, which, combined with a twisting and drawing motion of the clamps, produces the desired result.

* * *

Full details will be furnished by the manufacturer upon request.

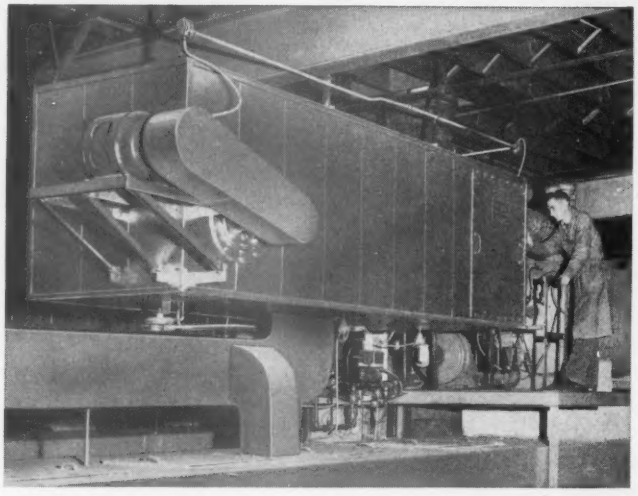
RR Tests Copperply Wire

A large western railroad is giving in-service tests to Copperply copper-plated communication conductors in a high-sleet area. **Copperply**, manufactured by the **National-Standard Company**, has received approval as communication conductor from the REA.

* * *

Five thousand pounds of 40 per cent conductivity No. 8 insulated Copperply line has been installed in two parallel lines transposed for voice and 30-kilocycle carrier service in a dispatchers' circuit, strung 35 to 40 poles per mile. The insulation is 2/64-inch Neoprene. The insulated line is tied in with 10-

PARTNERS FOR PROFIT



Hydrocarbon exhaust vapors and catalysts form a partnership that provides low cost heat and safety for industrial processes.

The catalyst releases heat without flame, often several hundred degrees—from vapors usually considered too dilute to have value. Simultaneously the catalyst effectively eliminates noxious odors and hazardous condensate to provide a safe, inoffensive and often useful exhaust emission.

Hundreds of plants are saving fuel today with Catalytic Oven Heaters, and other types of catalytic combustors.

Consult your Oven Builder or write us direct for details on lifetime "All Metal" Catalysts, and catalyst heating systems.

U. S. AND FOREIGN PATENTS GRANTED AND PENDING

Catalytic Combustion CORPORATION

CATALYSTS • FUME ELIMINATION AND HEAT RECOVERY SYSTEMS

4722 Fourteenth St., Detroit 8, Michigan

gauge Neoprene-insulated annealed tie wire.

* * *

The copper is electrolytically plated on a steel core by a process owned and perfected by National-Standard. The plating can be applied in any thickness up to 40 per cent conductivity by simple control of the plating solutions. The copper-steel electrolytic bond is unaffected by drawing, bending, twisting and other working.

Fastener Report

Stanley-Humason, Inc. of Forestville, Conn., a subsidiary of **The Stanley Works,** New Britain, Conn., offers a "Special Report" on fastener products. The file folder contains engineering data sheets on the various types of fastener products manufactured by Stanley-Humason, Inc., with descriptions, advantages and specifications for such products as hour glass (hairpin) fasteners, special application nuts, flat spring, retaining ring and custom screw machine fasteners.

* * *

The company makes no standard catalog items but offers a complete custom service geared to manufacture components, designed, fabricated, and finished to meet customers' rigid specifications.

* * *

For further information, write: Stanley-Humason, Inc., Forestville, Connecticut.

Self-Identified Coils To End Wire Mix-ups

An exclusive development, providing positive coil identification of Page automatic welding wire, has been announced by the **Page Steel and Wire Division, American Chain & Cable Company, Inc.,** Monessen, Pa. Designed to end costly wire mix-ups, each coil of Page automatic welding wire now has the grade stamped on the inside of the liner, for instant identification.

* * *

In addition, liners on #2 coils are color coded with colored stripe on the liner. This feature provides double identification, putting an end to the scrapping of partly-used coils whose tags have been lost, and eliminating the use of the wrong grade where coils have been mixed in storage.

New Mylar Plant to be Built

A second plant for the manufacture of "Mylar" polyester film which will almost double the capacity for this strong film, will be built near Florence, S. C., the **Du Pont Company** has announced. Cost of the new plant will be about $20,000,000.

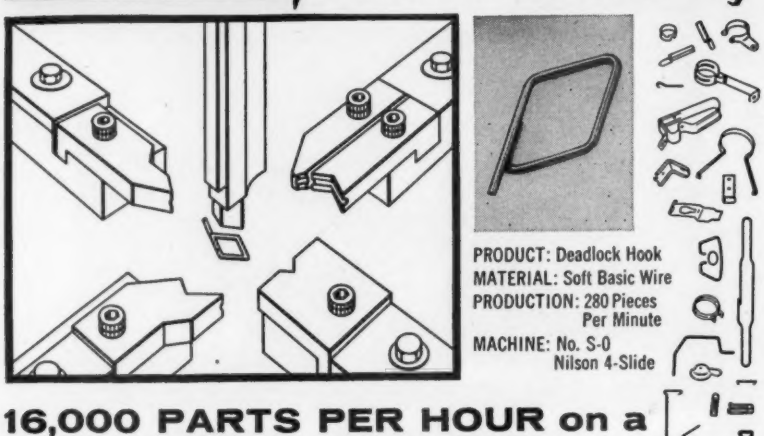
* * *

Construction started in June on a site about 10 miles east of Florence with completion of the plant expected early in 1961. Operated by the company's Film Department, the plant will employ about 500 persons when production reaches capacity.

New Copper Alloy Developed

A unique zirconium-copper alloy, possessing excellent electrical conductivity and high-temperature strength properties, has been developed by **American Metal Cli-**

NILSON 4-SLIDES FORMING PRODUCTION PROFITS... *Automatically*



16,000 PARTS PER HOUR on a NILSON *Automatic* 4-SLIDE

Whether your product is formed simply . . . or requires complex bending in several planes . . . a Nilson 4-Slide may be the solution to your production problems.

The sketch above shows the tooling used by a leading manufacturer to mass-produce metal hooks—at the rate of 280 pieces per minute! A Nilson 4-Slide has proved to be the most efficient, economical way to manufacture this product . . . and many other kinds of wire forms and small metal stampings.

Manufacturing costs must be kept down to meet today's competition. The combination of high speed and product uniformity—basic advantages of Nilson 4-Slides—means maximum production, minimum operating costs.

Before you design, tool, or specify manufacturing methods for your product, get in touch with Nilson. Over 60 years of experience with wire and metal forming applications can help you form better products . . . more profitably.

NILSON
THE A. H. NILSON MACHINE CO.
607 Bridgeport Avenue • Shelton, Conn

Automatic Wire & Ribbon Metal Forming 4-Slide Machines • Wire & Stock Reels • Wire Straightening Equipment • Automatic Staple Forming Machines • Special Wire Forming Equipment

max, Inc. This new, versatile material — known as Amzirc* alloy — consists of high-conductivity, oxygen-free copper and high purity zirconium.

* * *

This new alloy should find wide use in electrical equipment where there is a need for the combination of high electrical conductivity and good mechanical strength at elevated temperatures. Some applications to which it is especially suited include fine wire, resistance welding wheels and tips, rectifier bases, rotor wedges, studs for x-rays tubes, and electronic tube side rods.

* * *

Amzirc alloy is distinguished by the high strength level it develops through cold working and the extent to which it retains this strength at elevated temperatures. A typical bar of this alloy, cold-worked 60% and aged for one hour at 400°C, exhibits the following: tensile strength, 63,000 psi; yield strength, 59,000 psi; elongation, 12%; and electrical conductivity, 90-95%. At 400°C, the short time tensile strength is 46,500 psi. Additional cold-working increases the strength of the alloy without sacrificing ductility and electrical conductivity. Endurance tests show it to be far superior to unalloyed copper.

* * *

An eight-page booklet, illustrated with charts and graphs, is available upon request to: American Metal Climax, Inc., 61 Broadway, New York 6, N. Y.

* Registered U. S. Patent Office

Hi-Temp Thermocouple Wire

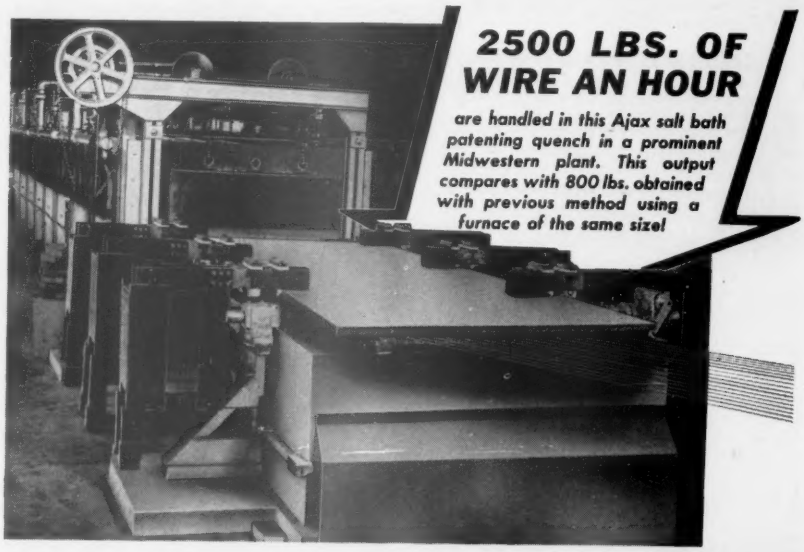
Revere MgO Insulated, Metal Sheathed Thermocouple Wires, designed to withstand ambient temperatures of 2000°F plus, are used where high temperatures must be accurately measured and where thermocouple leads must pass through zones of extreme heat. They are manufactured in long lengths with "thermocouple accuracy" conductors of either Chromel-Alumel or Iron-Constantan. Insulation is specially selected crystalline magnesium oxide compacted to maximum density inside the sheath. Inconel sheaths are completely impervious to moisture, oils, petroleums, ozone and solvents, and are immune to age deterioration. Twelve standard constructions, with wire gage sizes from 15 to 28, are available from stock. Special constructions can be furnished to a specified conductor resistance and with lengths longer than standard. Constructions having two Chromel and two Alumel wires in one sheath are also available.

* * *

For additional information, write to Revere Corporation of America, Wallingford, Conn.

Bearing Firm to Expand

Ground was broken on May 20 for the second million dollar expansion project at the Tyson Bearing Company plant, Massillon, Ohio, it was announced by E. R. Broden, president and chairman of


2500 LBS. OF WIRE AN HOUR
are handled in this Ajax salt bath patenting quench in a prominent Midwestern plant. This output compares with 800 lbs. obtained with previous method using a furnace of the same size!

Here's maximum speed, accuracy and economy in Wire Patenting!

AJAX
HULTGREN
SALT BATH FURNACES
Internally heated electric and gas-fired types

No other method offers so many possibilities for quality improvement and cost reduction in the patenting of high- and medium-carbon steel wire or rods. Automatic temperature control—an inherent result of Ajax internally-heated salt bath furnace design—provides continuous accuracy within ±5° F. throughout the bath. You are thus assured of the uniformity so vital to obtaining proper tensile strength and grain structure.

More poundage can be handled. Savings up to 30% in pickling time are common. Salt residue is easily removed by a water wash. The entire patenting process lends itself readily to inexpensive automation. Maintenance is negligible. Long-life, immersed-type electrodes can be changed in an hour or two—without tearing down furnace or pot. Pots last indefinitely.

WRITE FOR AJAX CASE HISTORY BULLETINS ON: ☐ Patenting; ☐ Process Annealing; ☐ Descaling; ☐ Cleaning, Preheating, Fluxing.

AJAX ELECTRIC COMPANY 928 Frankford Ave., Philadelphia 23, Pa.

the board, **SKF Industries Inc.**

* * *

Tyson, a division of SKF, completed the first phase of a $1,200,000 project in April and is now beginning a second project to provide an additional 33,000 square feet of production area.

* * *

Scheduled for completion by September, 1959, the combined projects will boost plant manufacturing area by more than 50 per cent. Tyson became a division of SKF Industries, Inc. in 1957. It manufactures tapered roller bearings for applications in jet aircraft, military equipment, food processing machinery, automotive, farm and transportation equipment.

IDA Members Meet

Morris Winston, President of the **Industrial Diamond Association of America, Inc.,** opened the Association's 14th Annual Meeting and Convention in May with a message of welcome. Mr. Winston pointed up the many activities in which the Association Committees were engaged, among them the Diemakers' participation in the National Stockpile Program of fine diamond dies; the U.S. Tariff Commission's revision and consolidation of Schedule No. 5, which deals with the importation of diamonds; the membership drive now underway; the approval of the B67.1 American Standard, Diamond Dressing Tools, co-sponsored by the American Society of Tool Engineers and this Association.

* * *

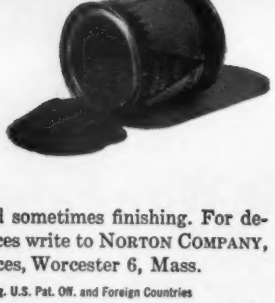
Mr. Winston also welcomed as an honored guest this year, **R. G. Weavind,** Director of Research, Diamond Research Laboratory, Johannesburg, South Africa, who presented a technical paper Wednesday on the "Factors Affecting the Efficiency of Resin-bonded Diamond Grinding Wheels."

* * *

IDA is located on the Newark-Hamburg Turnpike, Pompton Plains, N. J. The Convention included, besides 3 days of business and technical sessions, a Golf Tournament, officers' reception, and annual banquet.

Next to diamonds in hardness...

NORBIDE* abrasive costs 300 times less



Refinishing wiredrawing dies with NORBIDE* abrasive is your short cut to extra efficiency and economy. Next to diamonds and diamond dust, NORBIDE grain is the hardest manufactured abrasive commercially available. Yet it costs 300 times less than sized commercial diamonds.

Get the facts on how this Norton-developed abrasive can bring high quality and steady savings to your die refinishing operations — including ripping, semi-finishing and sometimes finishing. For details and prices write to NORTON COMPANY, General Offices, Worcester 6, Mass.

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries

G-374

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BORON CARBIDE

Making better products...to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electro-Chemicals
BEHR-MANNING DIVISION: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

Wire Forms Booklet

Four page guide on wire forming, strip forming, cold heading and threading includes design suggestion on how to best achieve lower wire products part costs; information on how to specify and order; manufacturers facilities for maintaining speed, precision and uniformity on wire products from 2″ lengths to some that require as much as 12′ to 14′ of wire in all metals and special alloys.

* * *

For a copy, please write **Robertson Steel & Iron Corp.,** 200 W. Commerce St., Cincinnati 2, Ohio.

Plasticizer Technical Bulletin

The Harchem Div., Wallace & Tiernan, Inc. 25 Main St., Belleville, N. J., has issued six pages of technical data on the newest of their polyester type plasticizers, Harflex 330.

* * *

This plasticizer lends permanence to vinyl compounds that would be resistant to migration into lacquers, varnishes, and polyslyrene. Its low volatility and low extraction properties are excellent

and electrical properties are good.

* * *

A copy of the data sheets comprising the bulletin are available from the manufacturer.

Portable Semi-Automatic Welding System

A fully illustrated, six page, two color brochure on the new Raco Dynaweld semi-automatic welding system has been announced by the **Reid-Avery Company, Inc.,** Dundalk, Baltimore 22, Md.

* * *

The Dynaweld system is a semi-automatic, shielded arc welding process with all the advantages of coated stick electrode welding but none of the disadvantages. It is completely independent of water cooling and gas shielding yet it lays down sound quality weld metal easily and continuously, operating from any standard AC or DC power source.

* * *

A brochure with full information as to specifications and applications, a two part chart on cost advantages, and a full catalog sheet of the complete line of Raco products is available from the Reid-Avery Company, address above.

National Safety Council To Meet in Chicago

The 47th annual National Safety Congress and Exposition to be held Oct. 19-23 in Chicago. Sessions on industrial safety scheduled for the Conrad Hilton, Congress, Sheraton, Morrison and La Salle hotels; traffic safety, Congress; commercial vehicle and transit safety, La Salle; farm safety, Palmer House; school and college safety, Morrison, and home safety, Conrad Hilton. Further information may be obtained from **R. L. Forney,** secretary, **National Safety Council,** 425 N. Michigan Ave., Chicago 11, Ill.

Litzler Acquires Ryan Industrial Division

The Ovens for Industry Division of **Ryan Industries,** Inc. has been acquired by the **C. A. Litzler Co., Inc.,** Cleveland, to broaden its line of continuous processing equipment involving heat transfer to cure and treat synthetic filament webs, coated metals and plastic materials.

* * *

Coincident with the transfer, **Dwight M. Wilkinson,** founder of Ovens for Industry, Inc. in 1947 and executive vice president of Ryan Industries for the past two years, joins the C. A. Litzler Co. as vice president in charge of sales. Wilkinson, a registered professional engineer who attended Case Institute of Technology prior to war service, started his career in this field with Industrial Ovens, Inc., where he held the post of chief engineer.

* * *

The acquisition will enable the C. A. Litzler Co. — an international leader in the design of giant tire cord processing units, wire insulating and plastic coating production lines — to give broader service to these processing industries and will facilitate expansion into allied fields.

* * *

The company is now established in new and larger quarters at 235 Brookpark Road, Cleveland 9.

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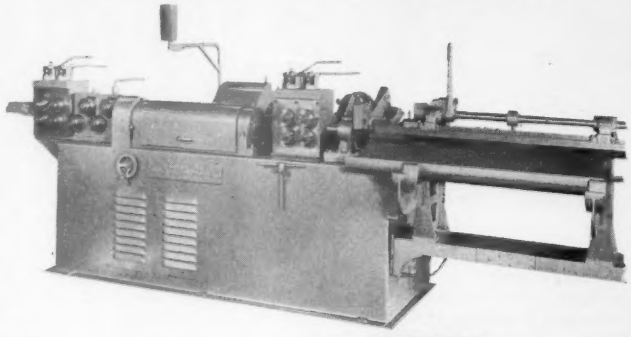
HI-SPEED
AUTOMATIC WIRE STRAIGHTENING & CUT-OFF MACHINES

MODELS AVAILABLE FOR ALL WIRE MILL REQUIREMENTS



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CAPACITY
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Catalyst Applications to Continuous Strip Ovens

(*Continued from page* 1348)

ated. It is obvious that some of the volatiles released from the work will find their way to the oven exhaust manifold without prior treatment through the catalyst in one of the preceding zones. While the arrangement shown would undoubtedly meet 90% of the existing air pollution control codes, where extremely strict regulations are in effect a still higher degree of decontamination may be necessary.

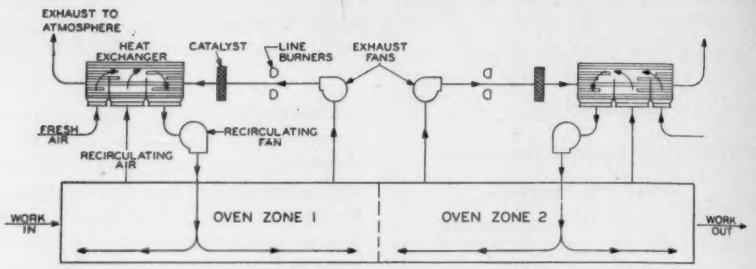


FIGURE 6

Some baking applications require indirect heating. Therefore, the products of combustion from neither the gas burner or catalysts can return to the baking chamber, where these may have a deleterious effect on the product. A typical two zone, indirectly heated oven is shown in flow diagram, Fig. 6. It is to be noted that the entire heating equipment for the oven is placed in the exhaust gases leaving the oven. Thus, the sensible heat contained in the elevated oven exhaust gases, as well as the heat of combustion from the solvents, are available to the exchanger.

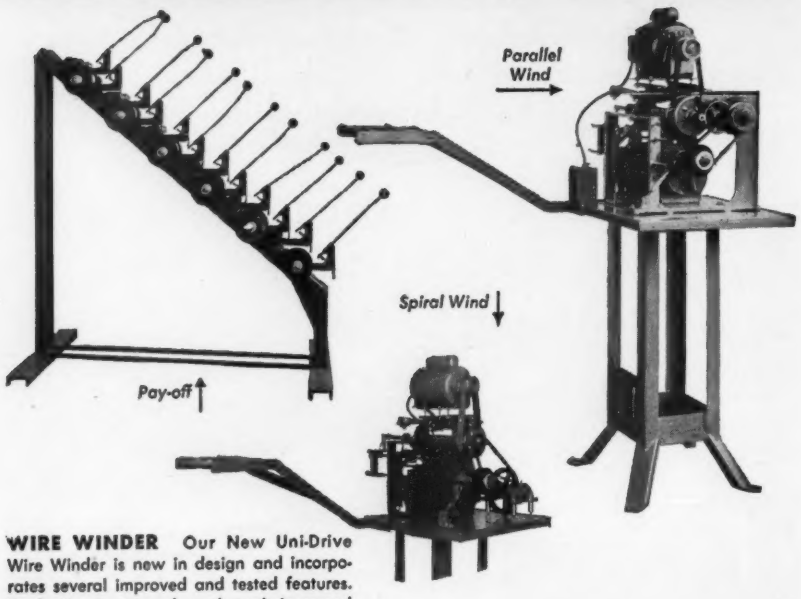
* * *

Control of the burner so as to maintain oven temperature is similar to conventional oven practice. However, after the burner has been reduced to pilot operation, should the calculated release of energy at maximum solvent load exceed the oven needs, the control instrument can transfer its function to operation of dampers in a heat exchanger by-pass duct, thus maintaining oven temperature control setting.

Amortization

Because ovens are designed individually, the difference in initial cost between the conventionally designed oven, and a Catalytic recovery type oven can only be individually calculated. Where opportunities appear to be favorable toward recovery, oven specifications should include a request to the oven builder to segregate the additional costs involved for incorporation of catalysts. The speed with which Catalytic recovery can be amortized is, of course, directly related to local fuel costs and concentrations of vapors passing through the catalyst. This relationship is shown in Fig. 7. It can be seen, for instance, that where local fuel costs are the equivalent of $1.50 per million BTU, and catalysts are so integrat-

STANDARD UNI-DRIVE WIRE WINDER



WIRE WINDER Our New Uni-Drive Wire Winder is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel — no over or under-winding. Can also be furnished with a slight spiral pattern for winding exceedingly fine wire. Automatic Stop Motion controls each strand. Traverse adjustable from 1¾" to 5½" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors.

Various types of supply packages that may be wound on Standard Uni-Drive Wire Winder.

PAY-OFF Our Pay-off Attachment consists of a heavy fabricated frame on which Pay-off spools are mounted to cover desired number of ends to be wound. Equipped with spindles, running on self-aligning ball bearings, with size of spindles and adapters to accommodate customers' pay-off spool. Compensating Attachment to control the tension of each individual strand of wire, applying the same tension when spool is full as when empty. Can also be adapted for use with bunching machines.

STANDARD MILL SUPPLY COMPANY
31 ESTEN AVENUE PAWTUCKET, R. I., U. S. A.

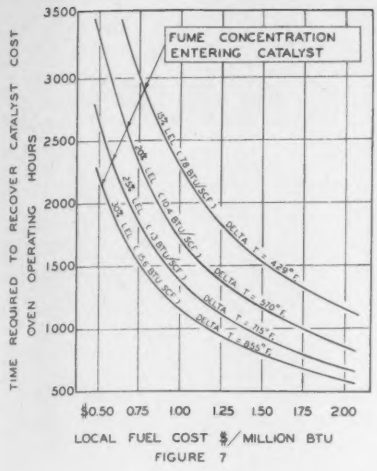


FIGURE 7

ed into the oven design that a concentration of 15% L.E.L. of hydrocarbon vapors is passing through them, the cost of the catalyst elements will be recovered in only 1500 oven operating hours. To this amortization time, however, must be added related component costs for incorporation of catalysts, which varies with individual oven designs. As a general rule, the overall cost of integrating Catalytic heat recovery to the design of new continuous strip ovens can be recovered in from four months to two years. This cost recovery time is invariably extended where Catalytic recovery is applied to existing ovens, due to the need for duplication of equipment components. Therefore, comparative economic studies are always recommended prior to the purchase of new oven equipment.

* * *

With the tendency toward higher fuel costs, the solvents released during baking operations represent potential heat energy of increasing value. The profitable utilization of this energy places correction of air pollution in the category of a secondary by-product.

* * *

Builders and users of all types of continuous strip ovens now draw generously from the catalyst application experience gained by wire enamelers. With increasing frequency, catalysts are incorporated as an integral part of new oven designs, where fuel cost and solvent load assure a rapid return on the investment.

New Cable Plant in Malaya

Newest of the joint venture factories to open up in Kuala Lumpur, Federation of Malaya, is **Malayan Cables Ltd.**, whose ten-acre site is located in the satellite town of Petaling Jaya.

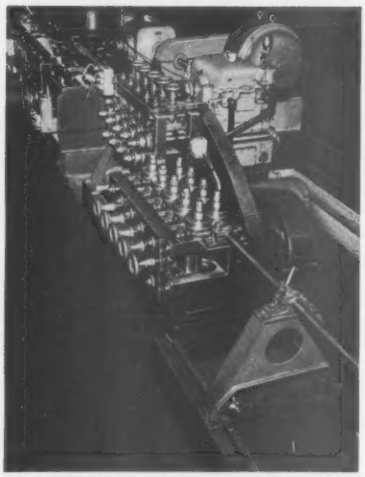
One-fifth of the authorized capital of M$5 million will be subscribed by Malayan investors and the remainder by several old-established cable companies of international repute.

* * *

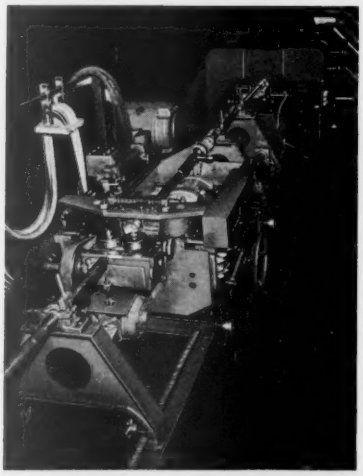
The establishment of this factory is an instance of the immediate success of the government's industrialization policy.

LOMATIC

COMBINED DRAWING STRAIGHTENING CUTOFF AND POLISHING MACHINE



Payoff - Drawbench - Straightener



Flying Shear - Polisher - Discharge

Now available in two standard sizes, the revolutionary LOMATIC machines handle ferrous and non-ferrous rods and tubes at speeds up to 200 ft. per min. and with drawing capacities up to 16,000 lb. Compared to conventional separate rod drawing, straightening, polishing and cutting-to-length operations, the LOMA single-operation fully automatic machine offers the following major advantages:

- Greater output rate — continuous operation at high speed
- Reduced labor cost — only one operator required
- Improved straightness — stock is straightened in two planes
- Perfect concentricity — obtained by straight-line drawing action
- Higher surface finish — due to two-stage polishing unit

The complete line comprises an uncoiler, a pre-straightener, a drawbench, a roller straightener, a flying cutoff, a polishing machine and a discharge table. All components required for the complete sequence of processing operations are interlocked mechanically and electrically into one integrated and synchronized line which is controlled by only one operator.

Our standard line of equipment includes:

- Casting Machines and Molds
- Saws and Cut-off Machinery
- Hot and Cold Rolling Mills
- Rod and Tube Draw Benches
- Roller and Stretcher Levellers
- Air and Hydraulic Tube Testers

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FASTER PRODUCTION LOWER COSTS A SNAP!

Electrix SEPARABLE PLUGS

You build better cord sets . . . faster and at lowest cost per finished unit with ELECTRIX Separable Plugs. Even more important, you get high quality, because ELECTRIX Separable Plugs have great holding power, a finer finished appearance, and pass the most rigid in-use tests.

Assembly is easy with the time-proven Electrix Automatic Attaching Machine.

Write for complete information.

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A RECENT NORTH AMERICAN INSTALLATION OF A SCOURING AND POLISHING PLANT WITH AUTOMATIC DUST AND SCRAP REMOVING.

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ISERLOHN • GERMANY

Quality Control in an Alloy Steel Bar Mill

(*Continued from page* 1292)

control. A sequence of these events is shown schematically in Figure 2.

* * *

Once the control variables and limits are determined, it is Statistical Quality Control responsibility to develop the technique to be used by production as a guide and assurance that specified control is being maintained. It is also Statistical Quality Control responsibility to train the production personnel involved to use the adopted statistical quality control techniques, to provide for their review and for a summary of the performance for management.

* * *

In our melting analysis problem, as a start, we had two variables we definitely wanted production to control to closer limits than had been previously specified in the melting instructions. The instructions were modified by the metallurgical representative, and control charts of the X moving R type were developed for the variables by Statistical Quality Control. Statistical Quality Control conducted two 2 hour training sessions for the involved production personnel. The basic techniques of frequency distribution, control charts and sampling were discussed. Then the personnel were instructed in the use of the specific charts they were going to use. To signify the completion of these two training sessions, these personnel were given the certificate that is given to all personnel completing the course. This certificate is shown in Figure 3.

* * *

The production personnel maintain the charts of the two variables. Figure 4, shows a typical chart of the type used for control of melting variables. Actually, to date, two more multiple regression analyses have been made on subsequent data. The production personnel now maintain charts on seven variables. The standard melting procedure instructions have been revised. An S.Q.C. issued report advises management of the performance in meeting the required chemical analysis range, Figure 5. The improvement is not only showing on such a graph for management, but also in specific categories of cost reports prepared by Works Accounting for management.

* * *

Thus the cycle of the product or process control phase of our quality control program is complete. A management report indicates an area where improved control is desired. Control is established or improved through a team representing the metallurgical, operational and S.Q.C. functions determining the control variables, the limits, training the operating department personnel to keep and use their own records, and measuring the effectiveness in management reports. This is product control through the control of the process.

* * *

There are other phases of the program that in themselves could be a subject for a paper. However, this discussion does illustrate the basic elements of our program. They include:

1. **A quality control organization represented at all levels, foreman to corporation.**

EQUIPMENT

Extruders
Takeup Equipment
Payoff Equipment
Spoolers
Respoolers
Measuring Machines
Capstans
Cable Strippers
Braiding Equipment
Twinners, Stranders, Cablers, Bunchers
Spark Testers
Printing Machines
Spiral Striping Machinery
Taping Equipment
Fine Wire Takeup and Respooling Equipment
Wire Drawing Machines
Specially Built Equipment
And Much More

SUPPLIES

Wire Drawing Dies
Wire Drawing Spools
All Types of Reels and Spools
Lithographed Spools
Inks for Printing Machines
Bare, Tinned and Silver Plated Copper Wire, Stainless Steel, Silver, Nickel, Bronze, Brass and Other Bare Wires
Numerous Other Items

all the wire industry in the West looks to 2 companies

First, there's Western Wire & Textile Machinery, Inc., the only company in the West that deals exclusively in used and reconditioned wire and cable-making equipment.

Secondly, there's the Paul I. Kenner Co., supplier and distributor of new wire and cable manufacturing machinery and supplies.

Nowhere else in the West will you have a better chance of finding exactly what you need - - - either new or used. Nowhere else in the West will you be able to trade in old equipment on new. Nowhere in the West will you find such a complete stock of machinery and equipment.

You'll like dealing with men who speak your business language - - - with companies backed by 20 years of highly specialized experience.

SOME EQUIPMENT ON HAND:

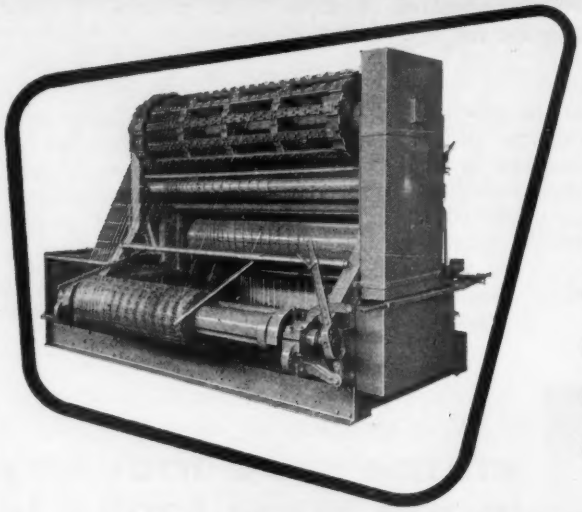
Takeups • Payoffs • Braiders • Asbestos Carding Lines • Taping Machines • 13 Die Copper Rod Breakdown Machine with Cook M-1000 Spooler Takeup.

2 Two companies that provide all that's needed, new and used for the West's wire industry.

WESTERN WIRE & TEXTILE MACHINERY, INC.
228 Shaw Road South San Francisco, Calif. Tel.: JUno 9-1101

PAUL I. KENNER CO.
228 Shaw Road South San Francisco, Calif. Tel.: JUno 9-1101

Interlocking FENCE LOOMS



- Fastest—Most Efficient
- Preferred by Leading Mills
- Low Maintenance Cost
- Wrapped Stay Fence
- Straight Stay Wires
- Integrated—Space Saving
- Replaceable Main Bearings
- Single or Double Strands
- Years of Low Cost Production

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SPECIALISTS IN FENCE LOOMS

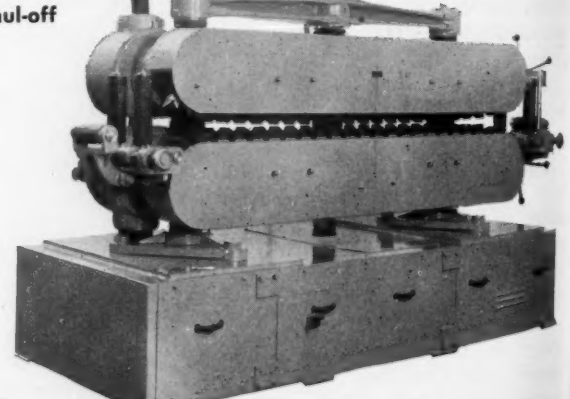
Leimbach *Haul-Offs*

for cable & plastic pipe

also

- Take-up and pay-off stands
- Armouring and plaiting machines
- Combined take-up & Haul-off machines

Roller type Haul-off Type B01
3/8" cable capacity. Maximum speed 1650 r.p.m.



Caterpillar Capstan Type 5A01
8" cable capacity, maximum pull 8000 lbs.

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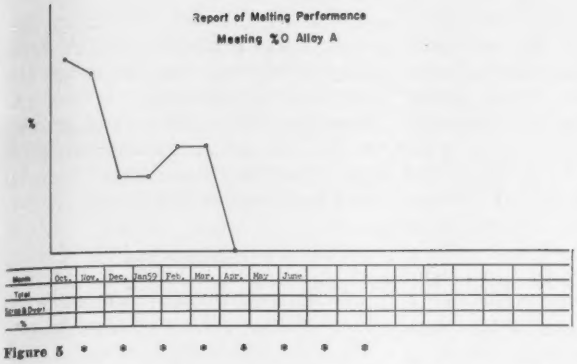

Figure 5

2. Corporation level support with vested authority.
3. Maintained communications — quality reports for management.
4. Production responsibility to conform to standard processing procedures, and to control.
5. Quality control training for those involved in the execution of the program.
6. Use of statistical analytical techniques.

The application of these basic elements in a coordinated program is giving us and our customers the benefits of Total Quality Control.

References

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2. "Statistical Quality Control: An Introduction for Management", D.H.W. Allan, Reinhold Publishing Corp., New York City, N.Y.
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The Manufacture and Properties of Basic Oxygen Steel for Wire Products

(*Continued from page* 1335)

Steel producers and consumers alike have shown great interest in the basic oxygen process. Under such stimulus, it is inevitable that studies concerning its processing, properties and uses will continue at an accelerated pace.

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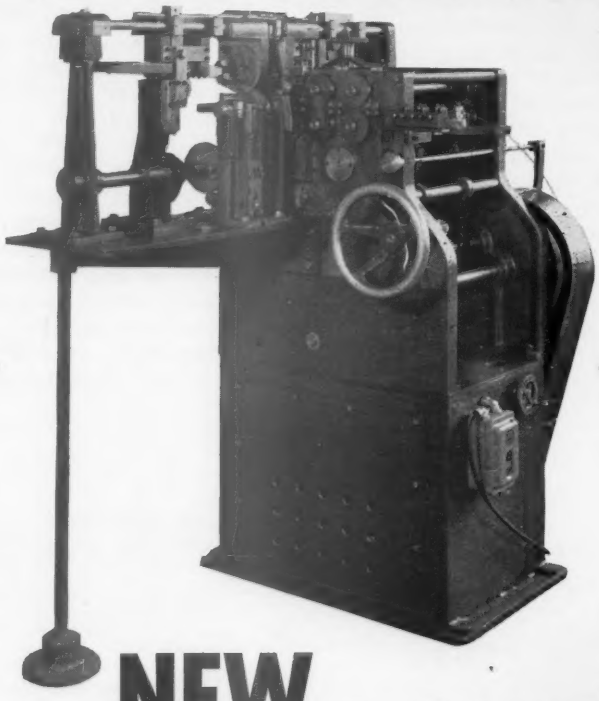

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Some Metallurgical Factors in the Manufacture of Fine Wire

(*Continued from page* 1352)

glass by evolution of gas contained in the wire severely limits the usefulness of such an assembly.

* * *

In the standard air-melting procedures, molten metal will pick up gas from furnace and ladle linings, from charge materials, from the air, as well as from mold coatings. Therefore, good melting practice calls for careful preheating of furnace, ladle, charge materials, mold coating, etc., at temperatures high enough to drive off adsorbed gases and moisture immediately prior to use. In vacuum melting and in melting under inert atmospheres, the same type of precautions must be observed. Every effort must be made to prevent the introduction of unwanted gases to the metal, if the resulting metal quality is to justify the cost of the melting process.

* * *

In air melting, some control of hydrogen content in the melt can be achieved by special techniques, depending upon the metal being melted. One is to deliberately oxidize the metal strongly (as with the oxygen lance) to increase the concentration of dissolved oxygen and thereby prevent absorption of hydrogen. Another is to cause a "carbon boil", in which carbon and oxygen in the metal combine to form carbon monoxide. Being insoluble, this gas leaves the melt in the form of bubbles which tend to sweep out other gases from the melt. A carbon boil also can be used in vacuum melting. Here, it is more efficient because of the low pressures used in this melting process.

* * *

In most melting procedures, additional control of gas content is achieved by the addition of small amounts of certain elements, loosely known as "deoxidizers". Thus, small additions of calcium, silicon and aluminum may be made to some metals to "fix" oxygen by forming the corresponding metal oxide. In the same manner, titanium may be added to "fix" nitrogen. However, the use of deoxidizers or "scavengers" is a mixed blessing. Frequently, the product of the chemical reaction in which they take part remains in the metal as a nonmetallic inclusion.

Shrinkage

Nearly all metals contract when they solidify. The amount of contraction varies from metal to metal, but is generally between 3 and 8 per cent by volume.

* * *

When the metal contracts during solidification upon being poured into an ingot mold, shrinkage cavities are formed in the ingot. This phenomenon is caused by the fact that the metal does not freeze uniformly from bottom to top, except in the cold-hearth consumable-electrode melting process mentioned earlier. Instead, the metal also freezes from the sides so that the effect of the contraction is felt in the interior of the ingot. The cavity thus formed is a "pipe".

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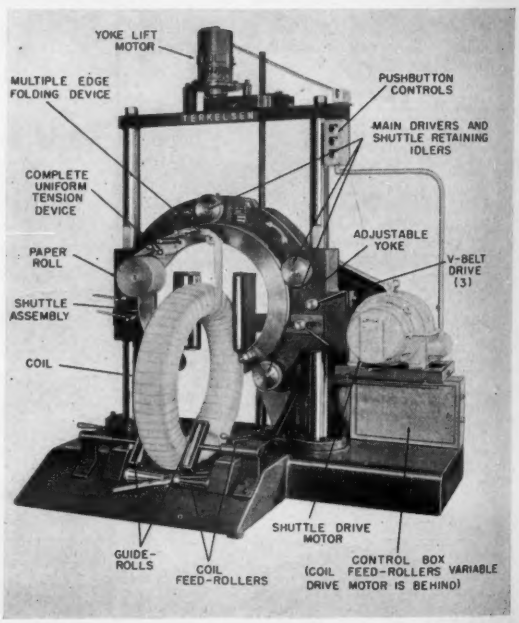

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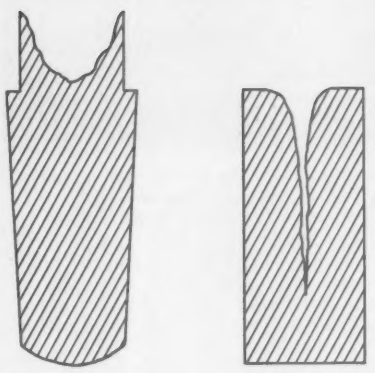
A well-designed ingot will contain an upper section called a hot top or sink head, and the shrinkage which occurs during solidification will be confined to the hot top. This section serves as a reservoir of molten metal which feeds the remainder of the ingot so that it will be sound when it becomes solid. Good and poor ingot designs are illustrated in Figure 6. The addition of an exothermic compound (which generates heat) to the hot top after pouring is an added step to insure that the metal in the hot top stays molten longer than the metal in the remainder of the ingot and will, therefore, be available for feeding. The hot-top portion of the ingot is removed later.

* * *

If poor casting practice and mold design are used, the pipe may extend deep into the ingot. In this case, pipe remains in the ingot even after the hot top is removed. As the ingot is processed into bar, rod, and wire the pipe remains in the center of the material as a defect



(a) Good design. Note ingot taper and hot top.

(b) Poor design. Note absence of both taper and hot top.

FIGURE 6. A COMPARISON OF WELL-DESIGNED AND POORLY-DESIGNED INGOTS

which may reduce the quality of the metal and detract from drawability. A common way in which a pipe destroys drawability is to cause the material to split.

Hot-Working Practice

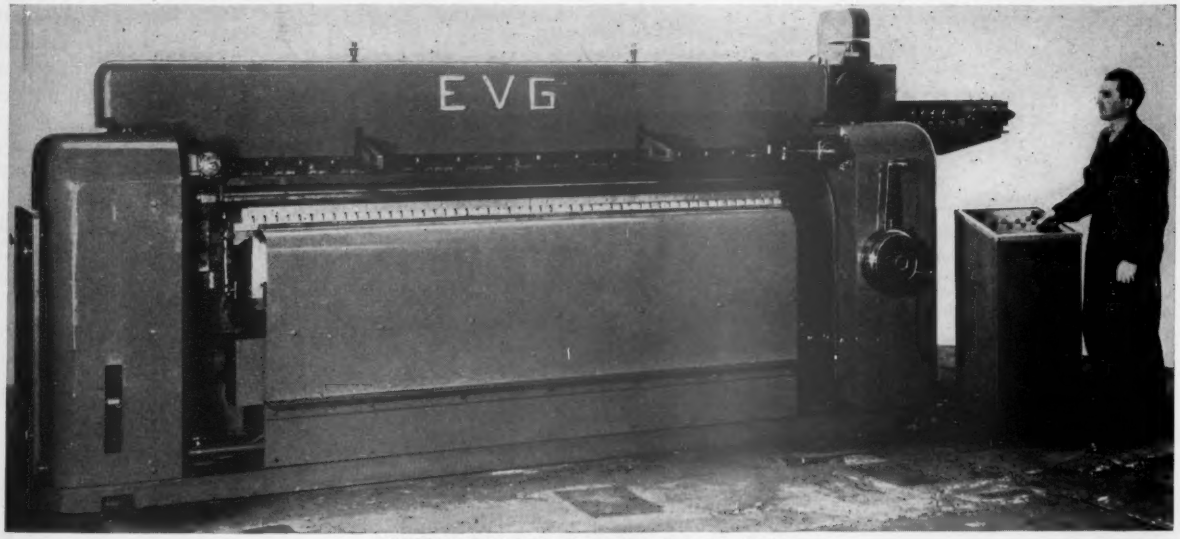
The ingots are commonly reduced to wire rod by deforming them at high temperatures where they are relatively plastic. Hot working converts the cast microstructure into a finer grained, stronger and tougher structure. Hot deformation also tends to heal or weld internal voids and gas holes, as well as to promote chemical homogeneity of the metal.

* * *

Prior to hot-working the as-cast ingot, any fins, cold shuts, or surface imperfections should be removed from the ingot surface. In some instances, however, the alloy may be too sensitive to thermal shock in the as-cast condition to be ground without forming cracks. In these cases, the fins, cold shuts, or other surface defects must be removed without touching the ingot proper.

* * *

The reduction of the ingot to wire rod by hot working is usually accomplished by a combination of pressing, forging, and/or rolling operations. In heating the ingot prior to hot working, care must be taken that the ingot does not remain at the elevated temperature



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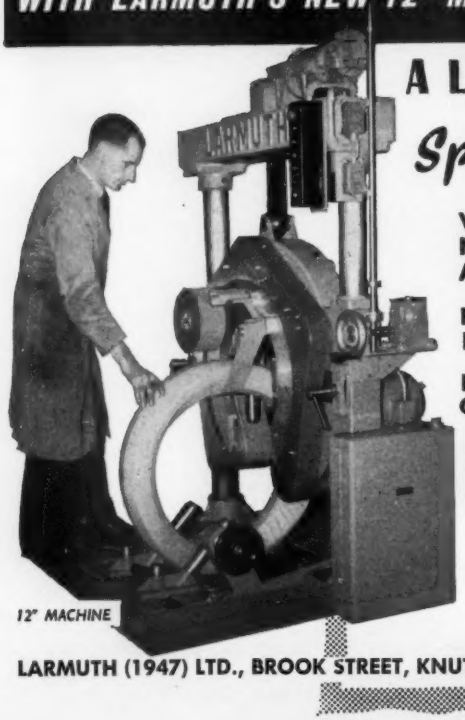

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for extended periods of time, i.e., for any longer than is necessary to thoroughly heat it throughout. Heating the ingot for too long a time or at too high a temperature can result in excessive oxidation, nitriding, carburization, or decarburization of the surface, depending on the alloy and the furnace atmosphere. During hot working, this surface contamination would be squeezed into the bar. Unless extreme care is taken to remove all traces of the contaminated area (and this may be difficult to do), these "squeezed-in" areas can open up to form "checks" during subsequent processing. An example of such "checks" is shown in Figure 7. They decrease the drawability of wire, even in relatively large diameters.

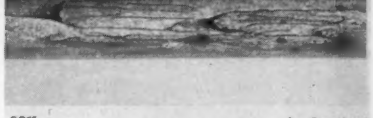
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FIGURE 7. "CHECKS" IN 50-MIL WIRE

As the bars are rolled to wire rod, care must be taken to adjust the mill so that the metal does not overfill the passes with the formation of fins along the edges. These fins, shown in Figure 8, lap over during subsequent rolling or drawing to form seams which decrease wire drawability to fine sizes. In addition, care must be exercised to prevent the rolling-in of foreign matter.

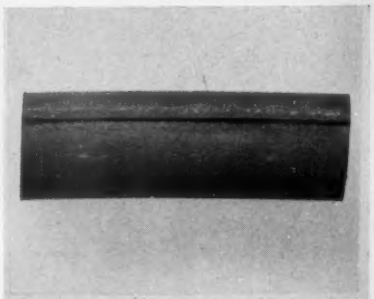
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FIGURE 8. 1/4-INCH ROD CONTAINING FINS

Mill speeds during rolling are also quite important. For instance, some non-ferrous alloys heat up excessively and check during rolling

at the speeds customarily used for steels. Consequently, adjustment of the mill to a slower speed is necessary for the production of defect-free wire rod. In some cases, the opposite effect is noted. That is, the metal cools down so rapidly during rolling that the mill must be run at a higher speed to keep the metal within the hot-working temperature range.

Annealing And Cleaning Practice

After the material has been processed into wire rod, it is softened by annealing and further reduction is accomplished by means of cold drawing. During cold drawing, the metal work hardens. The build-up of work hardening eventually makes it necessary to reanneal the metal before further deformation can be accomplished. Reannealing may be required several times before the desired final fine size is reached.

* * *

As-rolled wire rod is frequently batch annealed prior to drawing. This is generally accomplished in a gas-fired, oil-fired, controlled atmosphere, or salt-bath furnace. In any case, regardless of the type of atmosphere or furnace, the environment must be free from contaminants which would adversely affect the metal. For instance, in annealing nickel and nickel-base alloys the use of a high-sulfur oil or gas in the furnace could lead to sulfidation, i.e., the formation of sulfides at the surface of the rods by reaction of the alloy with the sulfur-containing compounds in the products of combustion. These superficial sulfides greatly impair wire drawability. The same kind of precautions apply to salt baths. Entrainment of sulfur-containing lubricants, for example, will build up a sulfur concentration in the bath which may sulfidize the metal.

* * *

In oil-fired furnaces, care should be taken that droplets of unburned oil do not fall on the metal. Local carburization may result. In addition, direct impingement of the flame on the metal is to be avoided. It may lead to local overheating, excessive localized scaling of the

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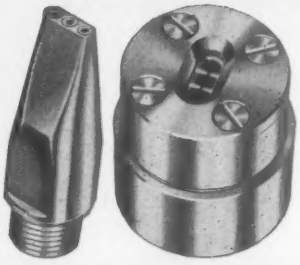

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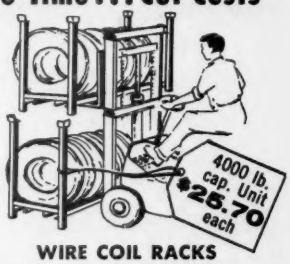

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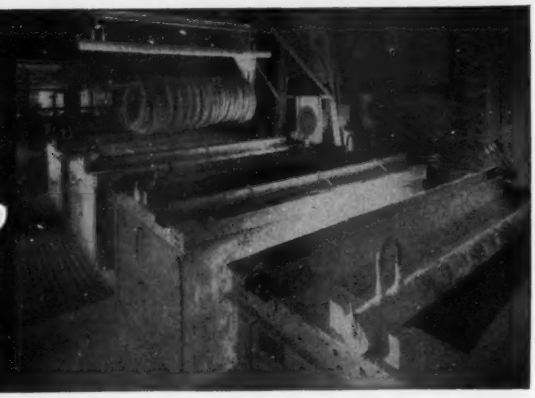

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metal, or even carburization if the flame is reducing. In controlled atmosphere furnaces using cracked ammonia, it may be wise to insure that no raw ammonia enters the muffle. It may "crack" on the surface of the metal, causing nitriding and hydrogen pick-up by the metal.

* * *

The time and temperature of annealing are important factors in fine wire production, whether the material being annealed is hot-rolled wire rod or is cold-drawn wire. Conditions should be adjusted, for most metals and alloys, so that the elongated grain structure produced by cold drawing (or by the last passes in the bar mill) is completely replaced by an equiaxed grain structure. That is, complete recrystallization of the structure is usually desirable. Moreover, some subsequent grain growth during annealing is frequently preferable to retard work hardening during the next series of drawing operations. However, if the recrystallized grains are allowed to grow too large, the material may become brittle and difficult to draw. For other alloys, even a small amount of grain growth usually is to be avoided. The anneal should merely remove the internal stresses built up by cold drawing and cause recrystallization. After annealing, any oxide scale or other surface compounds produced during annealing must be removed. This is sometimes done by blasting and other methods, but is usually accomplished by pickling. If pickling is chosen, the pickling medium, time, and temperature should be controlled so that the rods do not pick up hydrogen from the pickling bath. Hydrogen picked up in this manner has been found to cause a marked decrease in the ductility and drawability of many metals and alloys. In many cases, however, hydrogen can be removed by a low-temperature baking treatment.

* * *

The need for care during the cleaning operation cannot be emphasized too strongly. The drawing of rod which has even a slight oxide coating or grain boundary oxide penetration can lead to serious drawability problems. The

mottled appearance of some ¼-inch diameter wire which had been cold drawn without being pickled after the anneal is shown in Figure 9. The condition of the material

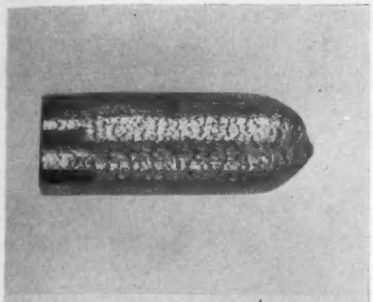

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FIGURE 9. 1/4-INCH ROD COLD DRAWN WITHOUT BEING PICKLED AFTER ANNEALING

as shown with the microscope is illustrated in Figure 10. This rod would not draw below about 25 mils.

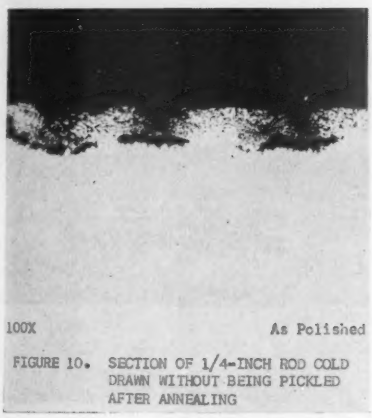

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FIGURE 10. SECTION OF 1/4-INCH ROD COLD DRAWN WITHOUT BEING PICKLED AFTER ANNEALING

Closure

It is evident that the production of fine wire, from melt to finished product, is by no means a haphazard procedure. It is one which must be carefully considered from many viewpoints. Among these viewpoints are those of the wire drawer and the metallurgist — the wire drawer being concerned with the processes of reducing the wire to the desired finished size and the metallurgist with providing the wire drawer with good quality material to process.

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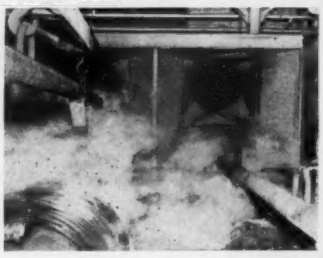

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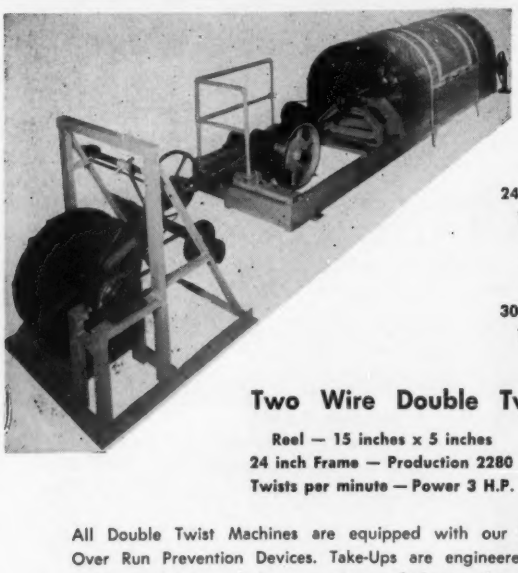

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The Drawing and Handling of Long Production Run Wire Coils

(*Continued from page* 1283)

inside diameter and packaging procedure. Recent mechanical developments in the wire mill have shown that sizes finer than .072" can be more satisfactorily produced on a stationary block.

Fig. No. 6—Long Production Run Coil of #14 Spring Wire

This stationary block machine is an auxiliary part of a conventional drawing machine which makes one additional draft possible by means of rotating a flyer around a horizontal stationary circular block to pull the wire through the die. When a sufficient number of rings has accumulated on the horizontal block, the wire pushes forward and falls onto a vertical carrier. This wire carrier may be removed when full, and then replaced immediately with an empty carrier reel without stopping the wire drawing operation (see Figure No. 7).

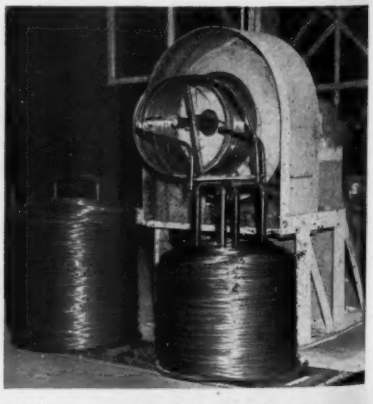

Fig. No. 7—Drawing Wire on Stationary Block

Coils produced for shipment are transferred to a specially designed carrier reel from the drawing machine for delivery to an automatic strapping machine. This reel is equipped with four collapsible carrier arms at the bottom, in place of the round carrier plate used on reels for interdepartment wire transfer, for pay off from an adapter base. The collapsible type reel is necessary here to allow for the strapping of the wire coil on the reel and for the removal of the reel out of the coil after the strapping operation.

* * *

The coil and the reel are placed on a dual head strapping machine for compacting with four ¾"x.044" steel strapping. The coil and the reel, after the strapping and sealing operation, are removed from the machine, the carrier arms are released, and the reel is pulled out of the bundle. The four straps are anchored around the coil circumference by means of #11 gauge annealed wire to prevent slipping of the straps during handling in transit and in customer's plant. (See Figure No. 8).

Fig. No. 8—Wire Coils Loaded in Boxcar for Shipment

For truck or boxcar shipment, the coils are loaded with the eye of the coil in a horizontal position for unloading with a fork tractor. Each shipment, whether loaded on truck or into a boxcar, must be securely braced and fastened by means of steel straps; and in boxcars, by end gates and strapping to hold the coils intact while in transit. Loading and unloading is accomplished in much shorter time than it takes to handle regular mill weight coils (see photos No. 9 and 10).

* * *

Upon arrival at the customer's plant, the coils are unloaded by means of a fork tractor. The coils are placed in storage, with the eye

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Fig. No. 9—Wire Coils Loaded on Truck for Shipment

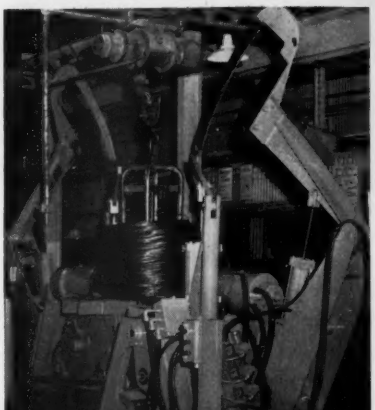

Fig. No. 10—Dual Head Strapping Machine

in a horizontal position, usually tiered two or three high (see picture No. 11).

Fig. No. 11—Long Production Run Coils in Storage

In the handling of the long production run coils from storage to the machines, a carrier reel is inserted through the eye of the horizontally positioned coil. The coil is tipped to a vertical position using

the carrier reel and fork tractor. The long production run coils may feed the customer's wire processing machines using either stationary or revolving pay-off reels.

* * *

The switch from the production of catchweight coils to the long production run heavy-weight coils has resulted in an overall increase in output per man-hour in our wire production, in the welded fabric operation, and in other processing departments. Wire users who have converted to long production run coils also report shorter unloading time, reduced storage space, savings in man-hour costs, substantial reduction in coil-remnant scrap — resulting in increased yield with significant reductions in overall manufacturing costs.

Trends in Copper and Copper Alloy Rod and Wire

(*Continued from page* 1288)

the header foreman. Extrusion and die scalping have practically eliminated this type of defect. Wire with grain structures running from .005 mm up to .070 mm in all combinations of drafts permit the widest selection of properties and behavior. Combine this with the alloys available and the selection is limitless.

* * *

With the development of the fine grained annealing practices, spring wire took on a new look. Mechanical properties were increased for a given drafting and the fatigue strength enhanced. This processing technique has been expanded to cover a number of brass mill products.

* * *

Wire drawing equipment and packaging methods have been wedded into the now popular barrel pack. However, this seems to be an intermediate stage and it looks like bigger and better equipment will combine to market an endless coil of wire.

* * *

Wire and rod processing equipment are intimately related to the effectiveness of meeting the new demands placed on the industry.

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I have briefly pointed out the general trend for metallurgical background and knowledge to combine with what might be called existing production faciliites to give new products to meet the expanding engineering demands of a Space Age. How well these talents work together will be resolved in the near future.

* * *

Certain areas can be pointed out which should be of concern to equipment builders for the wire and rod manufacturers.

* * *

Of immediate concern would be dimensional tolerances on both wire and rod. Some new concept for drawing must be devised to overcome such common failures as out-of-roundness, rippling, scoring, etc. Electronic measuring devices will pick out the defectives but the basic problem still remains.

* * *

Lubrication is always an interesting facet of wire drawing that is overlooked by the equipment manufacturers. There is a need for better design on the type, method of application, and control of lubrication in wire and rod drawing. Being of a fundamental nature, this problem of lubrication can have repercussions throughout subsequent processing operations and ultimately affect final fabrication. Considerable time is being spent by the research and development teams in the copper and brass industry to evaluate these fundamental lubrication principles.

* * *

Furnace construction, design, rate of heating, atmospheres, and the myriad factors affecting recrystallization and surface considerations are wide open for development. As the new alloys are released for production, the annealing and cleaning problems will be the major bottlenecks. High-temperature, high-strength alloys will probably be of a refractory nature calling for extremely critical annealing control and either atmosphere protection or radical cleaning facilities. In any event, present furnaces are probably not adequate for sustained production of highly specialized alloys that are scheduled to come from the re-

search groups. Present cleaning facilities will become antiquated.

* * *

Most alloys if properly cast will exhibit properties amenable to further cold working. Some may question this statement but those familiar with continuous-casting techniques will only nod in agreement. Until recently, very little widespread use of continuous-casting equipment has been applied to wire and rod production. Mostly it has been restricted to extrusion billets or rod bolts, thus precluding the obvious advantage of processing directly to the wire machines or draw benches. The use of the Properzi machine for aluminum wire production is in direct contrast to such equipment in the copper and brass industry. Recent developments, however, indicate that direct casting procedures have been adapted for certain copper alloys used in a large-scale wire production. This will certainly act as a stimulant for further research and development along these lines. The benefits will be widespread.

* * *

In summary, it can be said that a quiet revolution is in process in the copper industry. Old alloys are taking on a look of new respectability and fighting for survival against new alloy systems. The role of metallurgical engineering is opening up new vistas for the oldest metal known to man and perhaps the most vital for his survival in this Space Age.

The Use of Irradiated Polyethylene in Wire and Cable

(*Continued from page* 1299)

eight times the diameter of the cable (5″ mandrels in this case) and then were straightened. In the first test, the cables were immersed in water for one hour at room temperature. In the second test, the cables were immersed in water at 50°C for a week.

* * *

In the second test before the voltage breakdown values were determined, the insulation resistance was measured on the immersed ca-

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bles. The results are given in Table 4 for the average value of insulation resistance of the cables tested in each set.

* * *

Irradiated polyethylene has found use in a spacer type aerial distribution cable construction, where it is used as an outer wrap over polyvinyl chloride insulation. It is used because of its outstanding resistance to tracking or surface arcing. Where the cable is exposed to rain, snow, heat, cold, dust, salt spray, etc., leakage currents producing surface arcing are likely to occur. This arcing can degrade the insulation and form conductive paths. With polyvinyl chloride, for example, it is possible to draw an arc along the surface of the cable for several feet with severe damage to the insulation. When the arc is drawn on irradiated polyethylene, it is extinguished in a few inches with little damage.

* * *

This resistance has recently been demonstrated quantitatively in the Instruments Laboratory of the General Electric Company in Lynn, Massachusetts. Messrs. Norman, Pfuntner, and Kessel of that laboratory reported on their dust creepage test (3) which simulates the exposure conditions to which insulation may be exposed. The test consists of placing a 75 mil slab of the insulation on a metal ground plate. Two parallel bar electrodes are then placed on the sheet, one inch apart, with one grounded and the other carrying 1500 volts to ground. A partially conducting dust is spread on the sheet and continuously moistened with a tap water spray. Scintillations are constantly maintained between the electrodes. The time to breakdown is measured. The results are shown in Table 5 for selected compounds:

Table 5

Dust Creepage Tests

Material	Hours to Failure
Polyvinyl chloride	0.5
Neoprene	1.0
Chlorosulfonated polyethylene	1.0
Fluorinated rubber	18.0
Polyethylene	140.0
Unpigmented irradiated polyethylene	280.0

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It is believed that this superior resistance to surface arcing of irradiated polyethylene is due to the non-melting character of the material. The inability to melt and flow acts as a deterent to the formation of carbon tracks.

* * *

In the field of communication wire and cable, irradiated polyethylene is used as a heat barrier or binding tape in telephone cable. Typical of the construction is a core of several pairs of polyethylene coated wires, from six to 606 in number. These are wound with a core binding heat barrier tape, such as Irrathene irradiated polyethylene. Next, an aluminum or other metallic shielding tape is put on, followed by a jacket of thermoplastic insulation.

* * *

Irradiated polyethylene has several advantages particularly applicable for use as a binding tape. First, its high dielectric strength offers excellent additional protection to voltage surges along the shield. Second, the fact that it does not melt is important since it will not be damaged by the heat of extrusion of the outer jacket. This results in fewer rejects in cable manufacture. Next, the use of irradiated polyethylene tape provides more nearly uniform capacitance when compared to systems using other core binder tapes in equivalent thickness and construction. This results from the low dielectric constant which remains uniform over a wide temperature and frequency range. Finally, the strength of the film and its flexibility are such as to permit its application during manufacture with a minimum of difficulty.

* * *

In this application, it is necessary that the tape be readily peeled back when making splices. Therefore, the encapsulation and sealing properties are not needed. The regular general purpose grades of irradiated polyethylene are preferred.

Summary

Irradiated polyethylene tapes and films are finding a growing market as insulation for many types of wire and cable. This new form of polyethylene is useful because of the many advantages it offers including:

Voltage and thermal overload protection.
Excellent chemical and moisture resistance.
Long life under electrical stress.
Excellent resistance to tracking.
Ease in handling.

* * *

These benefits result from the outstanding properties of the irradiated material which include:

High dielectric strength.
Non-melting character.
Form stable to 200°C.
Protection against oxidation.
Stability of its excellent dielectric properties with temperature and frequency.
Stress cracking resistance.
Good mechanical properties.
The ability to shrink and bond to itself.

New and exciting developments are continuing in the field of irradiated products. It can be expected that new products will be developed using the benefits of irradiation to improve the properties of insulating materials for wire and cable.

References

1. **Symposium on Polyethylene, S-48 AIEE Conference October, 1951 Published July, 1952**
2. **NEMA standard WC-1-1955.**
3. **Norman, Pfuntner, & Kessel, Communication & Electronics, Number 25, July, 1956.**

The Rolling of Round Wire Into Flats and Rectangles

(*Continued from page* 1305)

pumped into the center of rolling mill rolls (Figure No. 22) to remove heat internally. Coolant can be splashed at the point of rolling

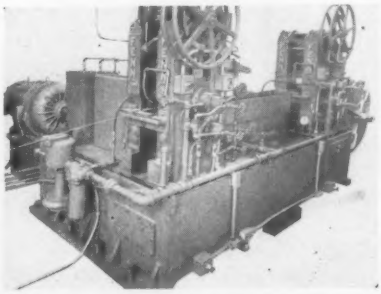
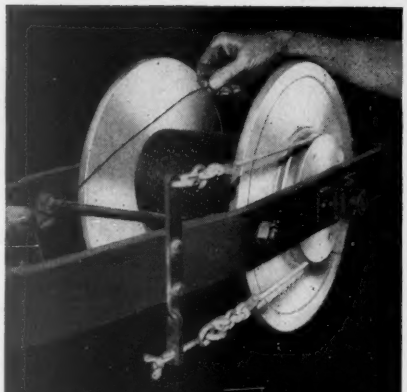


Fig. No. 22 * * * * * * *



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so as to remove heat on the surface of the rolls, and the wire. A coolant trough can be located between stands to further remove heat from the wire. If the heat in the wire is not removed, the next set of rolls would absorb it, thereby further increasing the temperature. By calculation it can be shown that an increase in diameter on a 8 inch roll of .0001 would be effected by a temperature change of 2 degrees Fahrenheit. It takes a great amount of coolant at room temperature to prevent a change of 2° F to take place. Coolant that has been cooled to below room temperature should be used in such cases. Where tolerances are not critical, coolant can be used as a method of controlling finished sizes. This can usually be done in the first stand of a line, by either using the external splashing on the wire, or by not using it. When it is being used, the wire will not spread as much, that is, the section coming through the mill will be smaller. Conversely, running dry will increase the width of the section coming through.

Automatic Lubrication

Where high speed and high production is called for there are several niceties or in automotive parlance, deluxe accessories, that should be incorporated into the line. The most necessary of these is an automatic lubrication system.

Carbide Shell Rolls

The use of Carbide Shell Rolls has been on the increase. They have a very definite place in wire flattening, especially when rolling high tensile materials, and/or small sections.

Continuous Gaging

The final item to be covered in this article is the use of continuous width, and thickness gages (Figure No. 23) in conjunction with a power screwdown in the rolling mill. These gages give the operator of a wire flattening mill a visual accounting of size coming out of the last mill in a line. If a variation begins to take place in thickness, he can make a quick adjustment from his bench by

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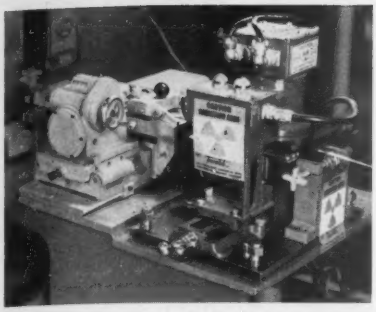

Figure 23 * * * * * * * * * *

push button operated screwdown. The thickness can be automatically controlled by a feed back control from the thickness gage. Width can also be controlled or corrected by use of a push button controlled screwdown on the stand previous to the last. This would be the first stand in a 2-Stand line or the second stand in a 3-Stand line.

* * *

I have attempted in this presentation to bring the major considerations in wire flattening by rolling; the machinery available; the selection of basic units to do a specific job; and techniques used in producing good quality wire. It is my hope that this discussion has been helpful to you and convinced you that rolling is the superior method for meeting the ever-increasing demand of industry for producing high quality wire to precise tolerances at ever-higher production speeds.

Aerial Tow Members

(*Continued from page* 1311)

with each aircraft. The horsepower required for the tow reel is dependent on system drag; thus, every effort must be expended to reduce tow member drag since it is the major contributing factor. In short, the production of tapered and/or stepped tow wire and strand, coupled with substantially higher tensile strengths, will permit better utilization of tow target systems which are necessary to provide essential air-to-air missile training for combat air crews at an acceptable cost.

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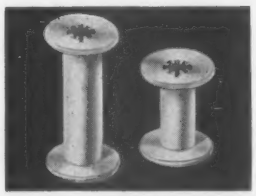

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Some Age Hardenable Copper Base Alloys for Wire Products

(*Continued from page* 1316)

strength advantages for the age-hardenable alloy is outstanding.

* * *

The unique combination of relatively high conductivity together with high strength and high corrosion resistance makes the age-hardenable copper alloys of great interest and importance to the electrical industry. However, other industries can profit from using this class of material. For instance, the property of being hardenable after cold forming operations opens up new possibilities in manufacture of such items as valve stems. Ordinarily, because they require high strength, such products are machined from bar stock or from highly alloyed cast blanks with a considerable generation of machining scrap. By utilizing the cold workability of these alloys before age hardening, it is possbile to cold head or cold upset and roll thread the necessary contour into a valve stem in what would be virtu-

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ally scrapless production. The shaded area in Figure G shows the

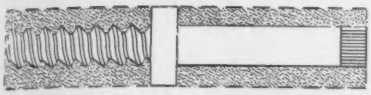

Figure G

amount of material which is scrap in cutting a typical valve stem out of bar stock. Such a valve stem produced by cold heading and roll threading from wire eliminates this scrap loss. To obtain the required high strength and high corrosion resistance, the parts are age hardened after they have been roll threaded.

* * *

Age hardenable copper alloys make it possible for the wire fabricator to produce items superior to those which can be obtained from other, sometimes more established methods of manufacture, and frequently at a considerable saving to the consumer.

References

1. D. K. Crampton, "Age Hardening Copper Alloys," *Age Hardening of*

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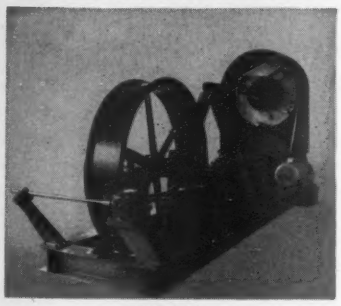

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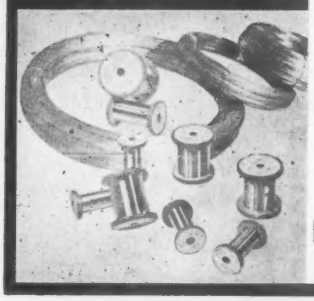

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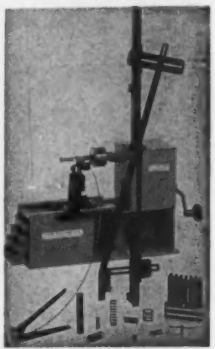
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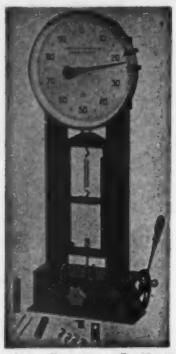
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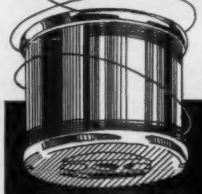
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Metals, 1940, p. 117. American Society for Metals.
2. W. D. Robertson and R. S. Bray, "Precipitation Hardening of Copper Alloys." *Precipitation from Solid Solution*, 1959, p. 328. American Society for Metals.

A Substitute for Silicon Bronze—Its Fabrication and Properties

(*Continued from page* 1344)

work done by **Mr. Thomas Hilton** who conducted most of the physical tests given in this paper and would like to thank **Mr. Lewis E. Thelin** of the Bristol Brass Corporation for the tests which he conducted and had conducted on the alloy and for his help in gaining recognition for this alloy.

Literature Cited

(1) 1957 Annual Report of Armour Research Foundation of Illinois Institute of Technology page 47.

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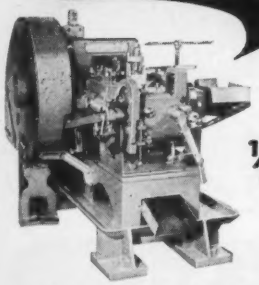

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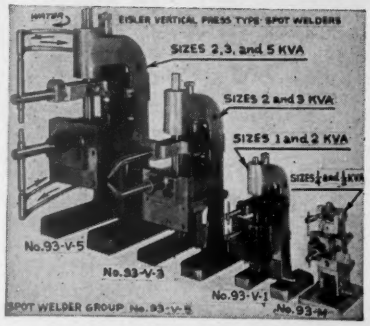

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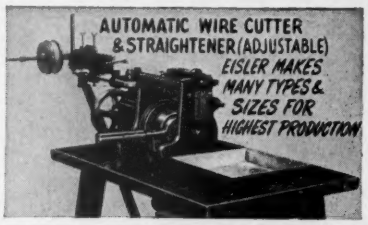

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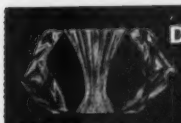
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1. The names and addresses of the publisher, editor, managing editor, and business managers are:

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FURNACES—Brazing
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Galvanizing Equipment
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.
Wilson Lee Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Resistance Heating, Strand
Harper Electric Furnace Corporation, Buffalo, N. Y.
Sunbeam Equipment Corporation, Meadville, Pa.

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.

FURNACES—Strand Annealing
Ajax Electric Company, Philadelphia, Pa.
Harper Electric Furnace Corporation, Buffalo, N. Y.
Ofenbau Fritz, G.m.b.H. & Co. K. G., Hagen, (W. Germany)
Sunbeam Equipment Corporation, Meadville, Pa.

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
Amchem Products Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS—
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
General Tire & Rubber Company, The, Akron, Ohio.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Takemura & Co., Ltd., New York, N. Y.
Waños Machinery Corp., Hackensack, N. J.

MACHINERY—Bobbin Winders
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

MACHINERY—Bolt, Rivet, Screw, etc.
Behr Machinery & Equipment Corp., Rockford, Ill.
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Takemura & Co., Ltd., New York, N. Y.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Braiding
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Link Fence
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Chain Making
Larmuth and Bulmer, Limited, Manchester, England
Pan American Supply Company, New York, N. Y.
Steel & Wire Machinery Co., Cleveland, Ohio
Waños Machinery Corp., Hackensack, N. J.

MACHINERY—Closing Cable
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N.J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Cold Heading
Behr Machinery & Equipment Corp., Rockford, Ill.
Boltmaster Co., The, Cleveland, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden
National Mach'y Exch (Used), New York
Showa Machine Works, Ltd., Osaka, Japan
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Pan American Supply Company, New York, N. Y.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Dead Block (Stationary Coiler)
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany
Pangborn Corporation, Hagerstown, Md.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Diameter Control
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Metallurgical Products Dept. of General Electric Co., Detroit, Mich.
Wayne Wire Die Co., Linden, N. J.

MACHINERY—Draw Benches
American Laubscher Corporation, New York, N. Y.
General Machine Tool Co., Worcester, Mass.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Edging (See MACHINERY—Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Royle, John, & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Wafios Machinery Corp., Hackensask, N. J.

MACHINERY—Flat Wire
General Machine Tool Co., Worcester, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Stanat Manufacturing Co., Inc., Westbury, L. I., N. Y.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Galvanizing Wire
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Insulation Testing (See MACHINERY—Spark Testing)

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia, Pa.
Cook Mfg. Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
EVG., Machinen & Stahl, A. G., Zurich, Switzerland

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Diam., Insulated Wire
Daystrom-Weston, Industrial Gauges, West Englewood, N. J.

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wisc.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providene, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Co., Tiffin, Ohio
National Mach'y Exch. (Used), New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Packaging Wire
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Paper Clips
Pan American Supply Company, New York, N. Y.

MACHINERY—Patenting Wire
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Pin Making
Takemura & Co., Ltd., New York, N. Y.
Wafios Machinery Corp., Hackensask, N. J.

MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industries Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Printing on Electric Wire
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Vaughn Machinery Co., Cuyahoga Fall, Ohio
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Ring Forming
Pan American Supply Company, New York, N. Y.

MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Slitting Mills
Steel Equipment Company, Cleveland, Ohio

MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Peschel Electronics, Inc., Towners, N. Y.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Special
General Machine Tool Co., Worcester, Mass.

MACHINERY—Spooling Tension Controls
Web Controls Corp., West Englewood, N. J.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Staple Making
Pan American Supply Company, New York, N. Y.
Wafios Machinery Corp., Hackensack, N. J.

MACHINERY—Straightening & Cutting
American Laubscher Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Patterson, George C. Machine Co., Cleveland Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Steel & Wire Machinery Co., Cleveland, Ohio
Takemura Co., Ltd., New York, N. Y.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Krupp, Fried., Machinen-Und Stahlbau Rheinhausen, Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
Advanced Wyrepak Co., Inc., Bridgeport, Conn.
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Enjaco Corporation, Cranston, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine) France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Thread Rolling
Boltmaster Co., Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cook Manufacturing Co., The, Paterson, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, (W.-Germany)
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.

Vaughn Machinery Co., Cuyahoga Falls, Ohio

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Collins Bros. Machine Co., Wire & Cable Mach'y Div., Pawtucket, R. I.
Cock Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.
Wire Machinery, Inc., Chicago, Ill.

MACHINERY—Welded Wire Mesh
E. V. G., Maschinen and Stahl, A.G., Zurich, Switzerland
Schlatter, Ltd., H. A., Zollikon/Zurich

MACHINERY—Wire Weaving
Takemura & Co., Ltd., New York, N. Y.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery—Welding Wire Fabrics)

MACHINERY—Winding Wire
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Enjaco Corporation, Cranston, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Machine Tool Co., Worcester, Mass.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Laubscher Corporation, New York, N. Y.
Atlas Polar Co., Ltd., Toronto, Ont., Canada
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Showa Machine Works Ltd., Osaka, Japan
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Machinery Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Takemura Co., Ltd., New York, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wire Machinery Inc., Chicago, Ill.

MACHINERY—Wire Forming
National Mach'y Exch. (Used), New York, N. Y.
Pan American Supply Company, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Takemura Co., Ltd., New York, N. Y.

MACHINERY—Wire Rope
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
American Laubscher Corp., New York, N. Y.
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio

NAIL TOOLING—Tungsten Carbide
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Central Tool and Machine Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAINT BONDING CHEMICAL
Amchem Products, Inc., Ambler, Pa.

PAINTS—Heat Resisting
Amchem Products, Inc., Ambler, Pa.

PAPER—Insulating
Twitchell, Inc., E. W., Philadelphia, Pa.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

PLASTICS—for Wire Insulation
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

PRINTING WHEELS—for Electric Wire
Daniels & Co., Frank, New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co., Inc., West Boylston, Mass.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Mettler Machine Tool, Inc., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett ,Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pull Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wood's Sons Company, T. B., Chambersburg, Pa.

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Steel, for Rope and Cable
New York Engineering Corp., Yonkers, N. Y.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Boonton Molding Company, Boonton, N. J.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Herculean Reel Company, Rusk, Texas
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Nelson Co., The, Baltimore, Md.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Herculean Reel Company, Rusk, Texas
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Nelson Co., The, Baltimore, Md.

REFRACTIONS—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pittsburgh Steel Co., Pittsburgh, Pa.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

ROLLS—For Flattening Wire
General Machine Tool Co., Worcester, Mass.

ROPE—Wire
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons, Div. Colorado Fuel & Iron Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—Plastic
Boonton Molding Company, Boonton, N. J.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

STOCK STORAGE SYSTEMS
Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div. Colorado Fuel & Iron Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, Ohio

TANKS—Ceramic, for Galvanizing
Ofenbau Fritz G.m.b.H. & Co. K. G., Hagen, W.-Germany)

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TENSION METERS—for Wire
Boulin Instrument Corporation, Pelham, N. Y.

TESTERS—INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT — Dielectric Faults in Insulation
Peschel Electronics, Inc., Towers, N. Y.

TESTING EQUIPMENT — Physical
Scott Testers, Inc., Providence, R. I.

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

TRANSMISSIONS—Variable speed (See Adjustible Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Insulating Materials Section, Schenectady, N. Y.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

WAXES—for Insulated Wire
Cary Chemicals, Inc., New Brunswick, N. J.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
E. V. G., Maschinen and Stahl, A. G., Zurich, Switzerland
Micro Products Co., Chicago, Ill.
H. A. Schlatter, Ltd., Zollikon-Zurich

WHEELS—for Printing on Electric Wire
Daniels & Co., Frank, New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co., Inc., West Boylston, Mass.

WIRE—Aluminum
Malin & Co., The, Cleveland, Ohio
Scovill Mfg Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Malin & Co., The, Cleveland, Ohio
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Bunched and Stranded
Camden Wire Company, Camden, N. Y.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Copper
Camden Wire Company, Camden, N. Y.
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
Camden Wire Company, Camden, N. Y.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Jones & Laughlin Steel Corp, Stainless and Strip Div., Detroit, Mich.
Montgomery Co., The, Windsor Locks, Conn.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado, Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Detroit Steel Corporation, Detroit, Mich.
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corporation, Pressed Steel Div., Cleveland, Ohio
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Metalizing
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Platt Bros & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio

WIRE—Needle
Marathon Specialty Steels, Inc., New York, N. Y.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., The, Cleveland, Ohio
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Detroit Steel Corporation, Detroit, Mich.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
National Lock Washer Company, The, Newark, N. J.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Keystone Steel & Wire Co., Peoria, Ill.
Marathon Specialty Steels, Inc., New York, N. Y.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Stainless Steel
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Jones & Laughlin Steel Corp., Stainless and Strip Div., Detroit, Mich.
Malin & Co., The, Cleveland, Ohio
National Lock Washer Company, The, Newark, N. J.
Nippon Stainless Steel Wire Mfg. Co., Ltd., Osaka, Japan
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Detroit Steel Corporation, Detroit, Mich.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A. Sons Div., Colorado Fuel & Iron Corp., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

YARNS—Wire Insulating
Synthetic Thread Co., Bethlehem, Pa.

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ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

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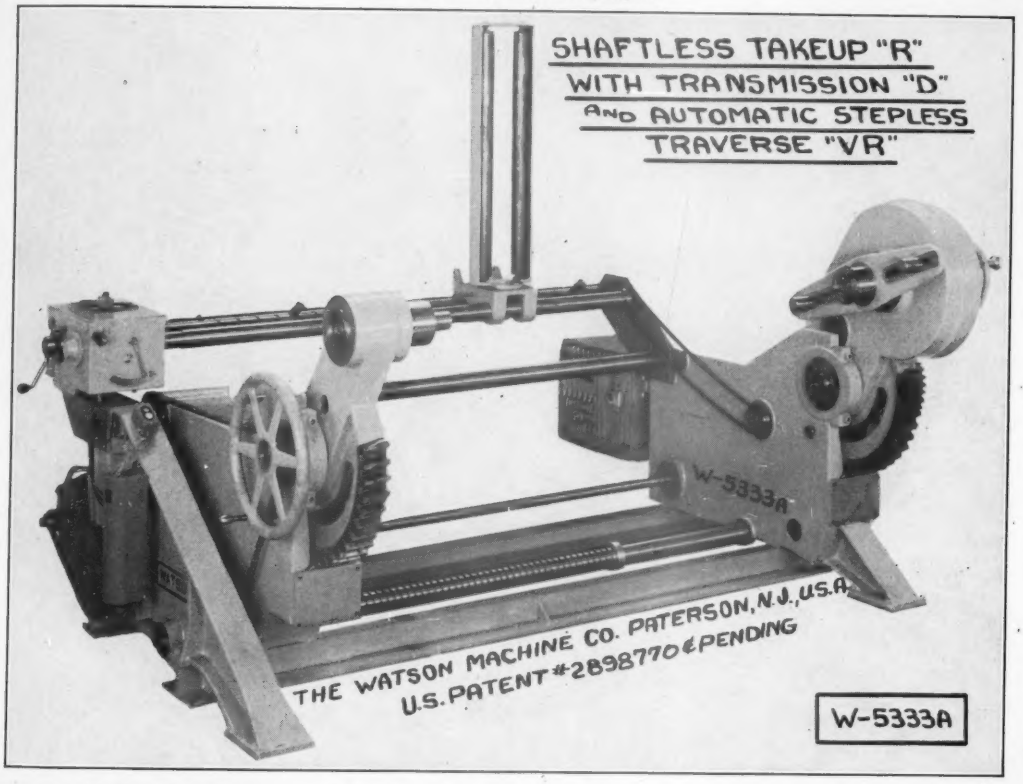

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HIGHER WINDING SPEEDS THAN OTHER TAKEUPS OF COMPARABLE SIZE.

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